Edison, Thomas Alva.

United States patents granted to Thomas A. Edison, 1869-1879.

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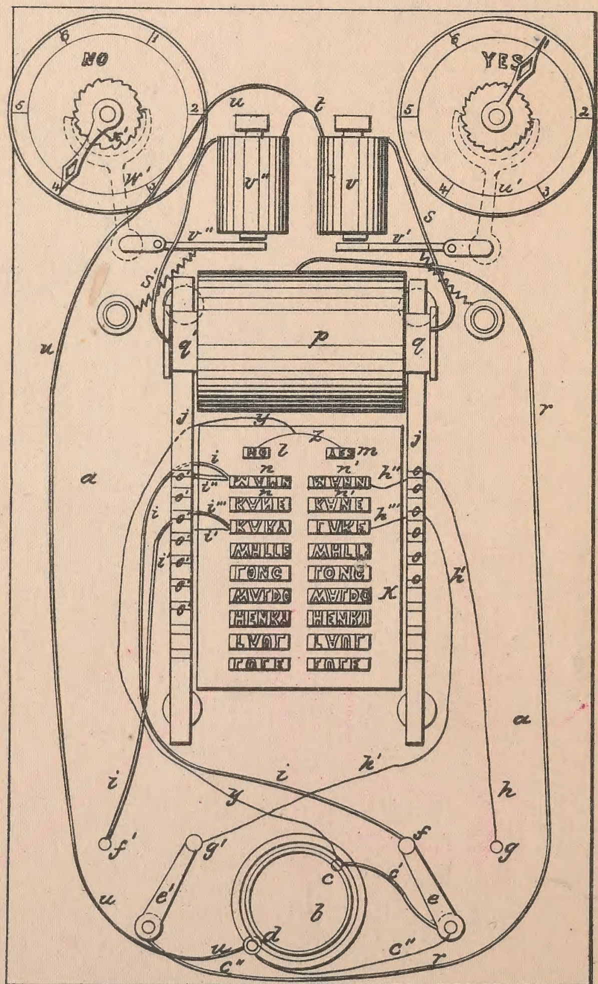
1869 — 1879

T. A. EDISON.

Electric Vote-Recorder.

No. 90,646. Patented June 1, 1869.



Inventor.
Thomas A Edison.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO HIMSELF AND DEWITT C. ROBERTS, OF SAME PLACE.

IMPROVEMENT IN ELECTROGRAPHIC VOTE-RECORDER.

Specification forming part of Letters Patent No. **90,646**, dated June 1, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful apparatus named "Electrographic Vote Recorder and Register," of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, which represents a plan view of the apparatus, and to the letters of reference thereon.

The object of my invention is to produce an apparatus which records and registers in an instant, and with great accuracy, the votes of legislative bodies, thus avoiding loss of valuable time consumed in counting and registering the votes and names, as done in the usual manner; and my invention consists in applying an electrographic apparatus in such a manner that each member, by moving a switch to either of two points, representing an affirmative and opposing vote, has his name imprinted, by means of electricity, under the desired head, on a previously-prepared paper, and at the same time the number of votes is indicated on a dial-plate by the operation.

Referring to the drawings, in the central portion of the plate *a a* is secured a block, *k*, upon which are set, in metallic types, two columns of names, *n n'*, the one being headed by the word "no," the other by "yes," each column containing the name of every voter, and the like names standing opposite each other, as Mann under head "no" opposite to Mann under head "yes," &c. The types are separated by intervening spaces.

Along two sides of the block *k*, and parallel with the two columns *n n'*, are two rails, *j j'*, composed of any good insulating material, as hard rubber.

Opposite the intervening spaces between two names the upper faces of the rails *j j'* are intersected by metallic strips *o o o o' o' o'*.

On the rails *j j'* are mounted two rollers, *q q'*, insulated from one another, and insulated from and surrounded by the cylinder *p*, in such a manner that the rollers *q q'* project beyond said cylinder *p* and rest immediately upon the rails. These rollers are metallic, and the larger one, *p*, is of such a size as to come in contact with a chemically-prepared paper placed upon the types, and is, furthermore, in communication with battery *b* by means of conducting-wire *r r*, or in any other suitable manner.

The rollers *q q'* communicate with the two magnets *v v''* by the wires *s s'*, and through them operate the armatures *v' v'''*, the escapements *w w'* and the pointers *x x'*, which latter show the numbers of votes on the dial-plates marked with as many figures as there are voters.

The battery *b*, with the two poles *c* and *d*, is connected with and operates the apparatus in the following manner: The pole *c* is in constant communication with the metallic types *l m*, representing, respectively, "no" and "yes," by means of the conducting-wires *y z*; but the pole *c* is connected by the wires *c' c'' c''*, with as many switches *e e'* as there are voters.

From the points *f f' g g'* the conducting-wires *i i' h h'* pass to the metallic strips *o o o' o'*, and from thence to the nearest metallic type, or they may pass first to the types and then branch back to the respective strips, as seen in the column to the left.

From the pole *d* of battery *b* communication is established with the cylinder *p* by the wire *r r*, and from the same pole by the wire *u u t* to the two magnets, where the aforesaid conducting-wires *s s'* lead to the two insulated rollers *q q'*.

The apparatus is placed before the recording clerk's desk, and a paper, which is previously chemically prepared for printing by electricity by saturating it in any known solution for that purpose, is placed upon the types, and covering the two columns and their heading.

Every voter is also provided with a switch, *e*, and moves the same *ad libitum*, as the occasion may require, on the point *f* or *g*. Thus an electric current is established between the pole *c* of the battery, the switch *e e'*, and the types *l m*, and the clerk then rolls the rollers *q q'* with cylinder *p* on the paper upon the types. As soon as the cylinder *p* comes on the type of the headings the circuit becomes completed through the paper, (as the wires *y y* connect the pole *c* with the types, and the wire *r* the pole *d* with the cylinder *p*,) and de-

composes the chemicals, thereby discoloring the paper in contact with the types, and thus produces the printing.

When the cylinder p comes over the two names—Mann, Mann—the current from pole c through switch e and wire i to the types bearing the name on the left becomes completed through the paper, with cylinder p, wire r, and pole d, and, discoloring the paper, produces the name Mann on the paper; but there is no connection of the other name Mann to the right with the switch and pole c; consequently no decomposition takes place, and no name shown.

The roller p passing on and leaving the types the circuit becomes broken; but as soon as the rollers q q' come in contact with the metallic strips o o' the circuit from pole c through the switch e, wire i i'', strip o', and through roller q', magnet v'', wire t and u to pole d, becomes closed, the armature v''' attracted the escapement w', and with it the pointer x' moved forward, and here one negative vote recorded, &c.

Thus, it will be seen, the names of all the voters are printed on their respective heads, and also the whole number of votes counted in an instant, or as long as it will require time to roll the cylinder p over the types containing the list of all the names in metallic types, with more dispatch and accuracy than it can possibly be done in any other way.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a switch or switches e e', types and cylinder p, with an electric battery, connected and operating substantially as and for the purpose set forth.

2. The combination of switch e, strips o o', types, and the separated and insulated rollers q q', magnets v v'', armature, escapement, pointer, and dial-plate, with the battery b, connected and operated substantially as and for the purpose above described.

3. The combination of switch, types, cylinder p, rollers q q', strips o o', and insulators j j', magnets v v'', armature, &c., constructed in the manner and for the purpose above specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS A. EDISON.

Witnesses:
CARROLL D. WRIGHT,
M. S. G. WILDE.

3 Sheets—Sheet 1.

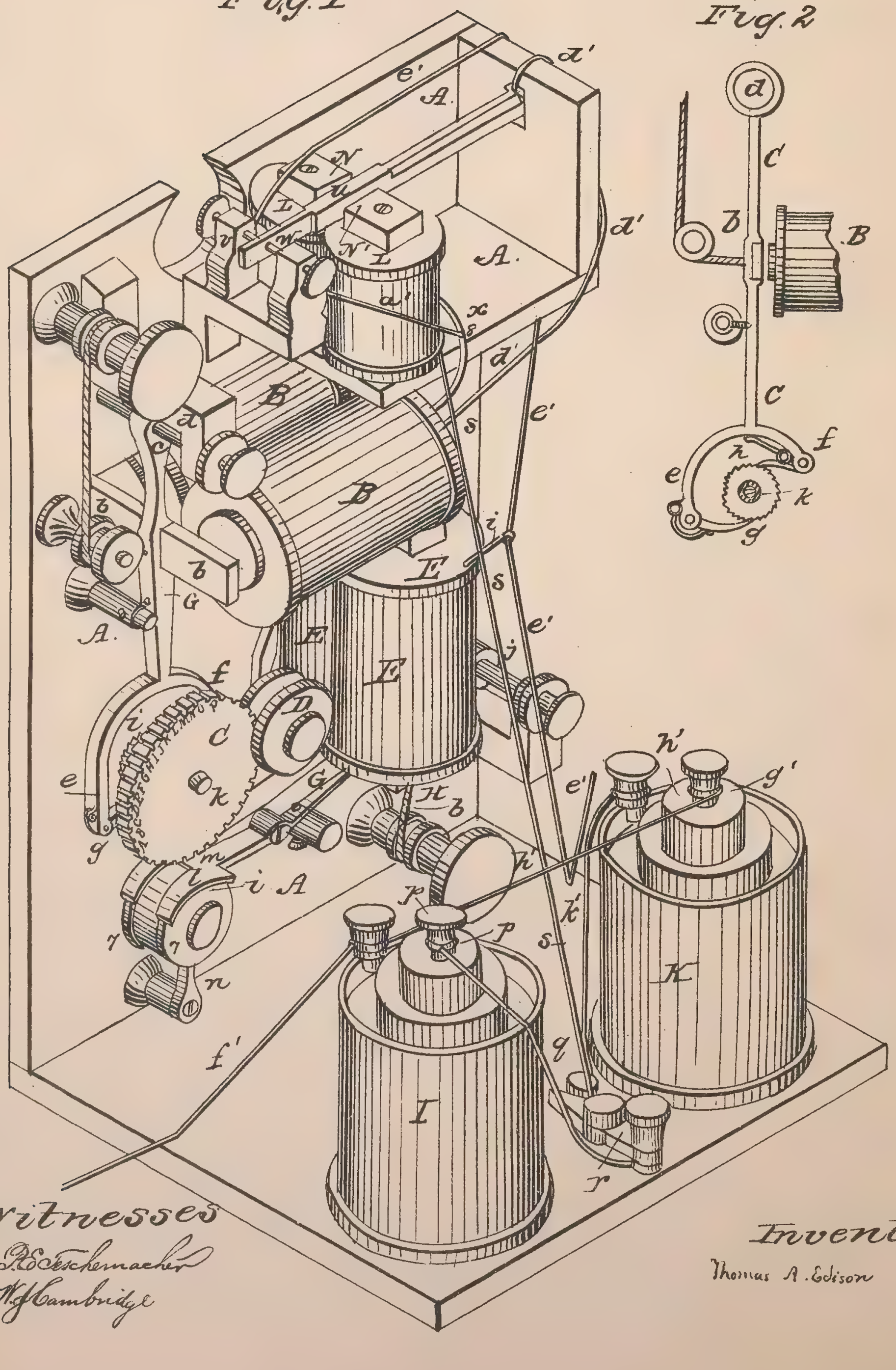
T. A. EDISON.

Printing Telegraph.

No. 91,527. Patented June 22, 1869.

Fig. 1

Fig. 2



Witnesses

P. E. Teschemacher

W. J. Cambridge

Inventor

Thomas A. Edison

3 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 91,527.

Patented June 22, 1869.

Fig. 3

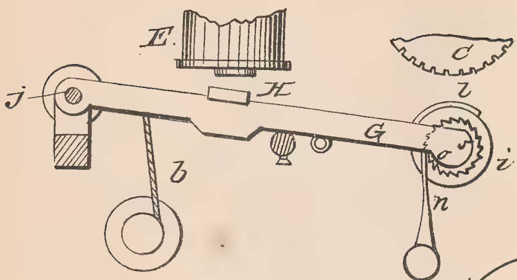
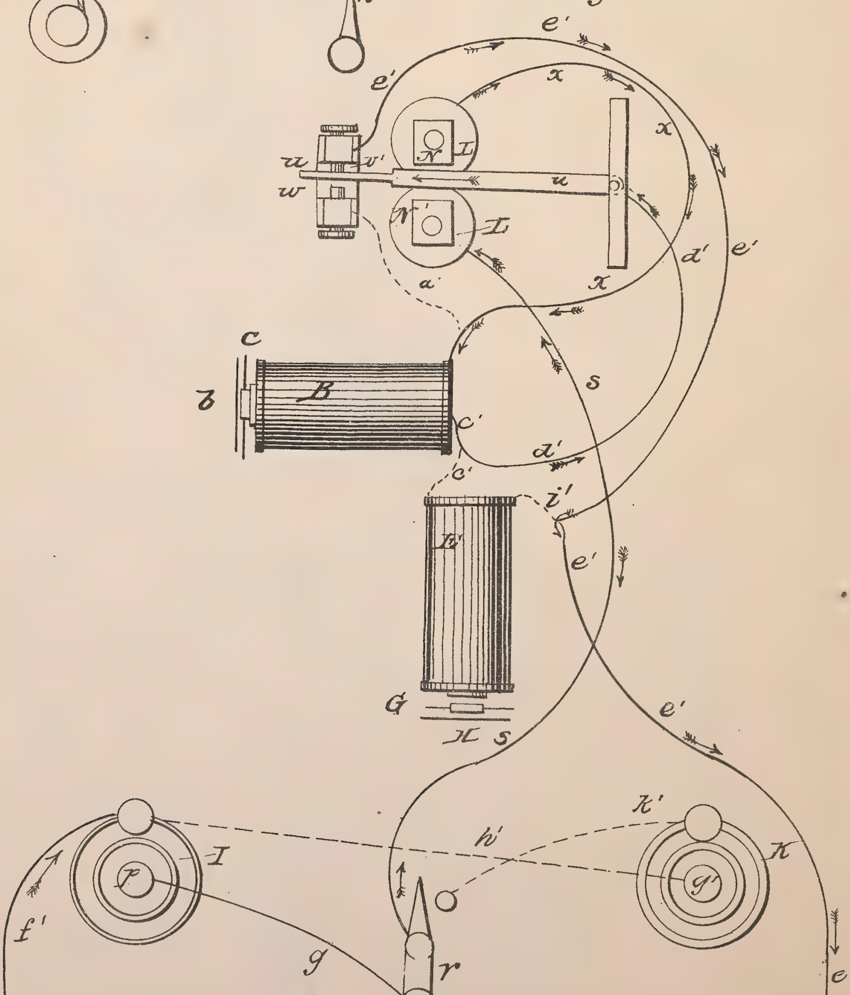


Fig. 4.



Witnesses

R. E. Fexhemacher

W. J. Cambridge

Inventor

Thomas. A. Edison.

N. PETERS, Photo-Lithographer, Washington, D. C.

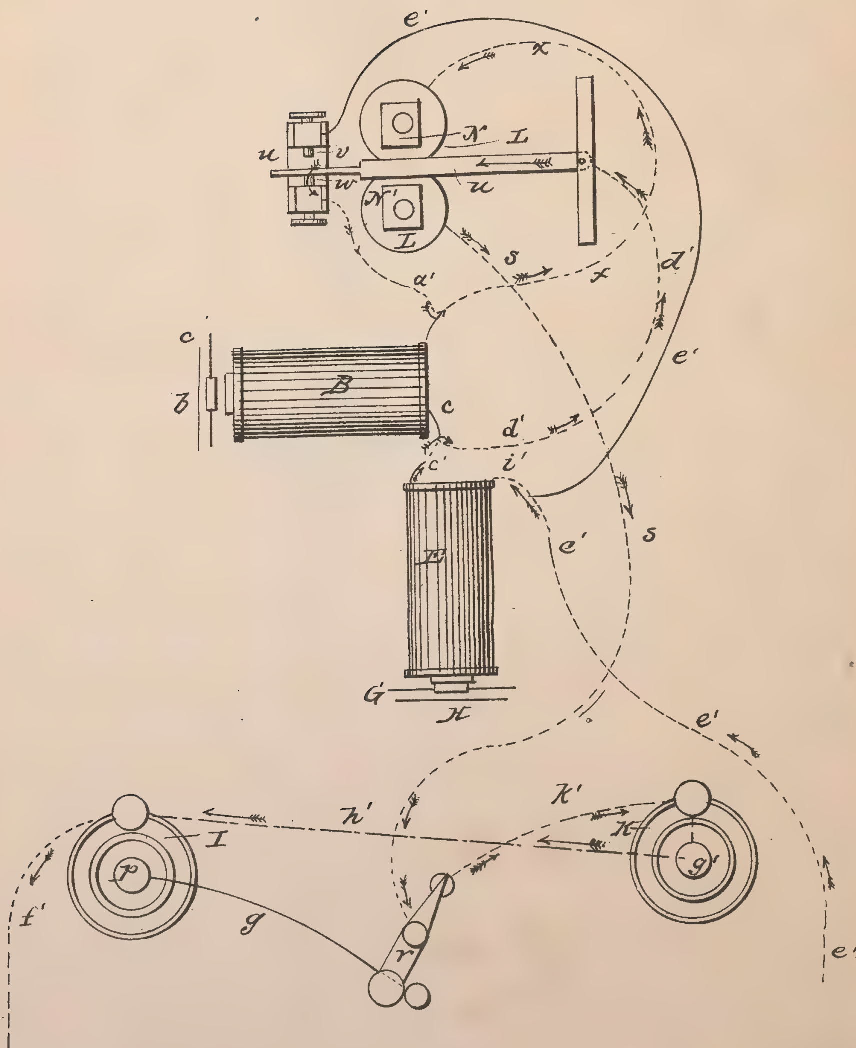
3 Sheets—Sheet 3.

T. A. EDISON.

Printing Telegraph.

No. 91,527. Patented June 22, 1869.

Fig. 5.



Witnesses

R. E. Teschemacher

W. J. Cambridge.

Inventor

Thomas. A. Edison

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF BOSTON, ASSIGNOR TO JOEL H. HILLS AND WM. E. PLUMMER, OF NEWTON, MASSACHUSETTS.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **91,527**, dated June 22, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Electro-Magnetic Printing-Telegraphs, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings making part of this specification, in which—

Figure 1 is a perspective view of my improved instrument; Figs. 2 and 3, details; Figs. 4 and 5, diagrams to be referred to.

This invention has for its object to produce a simple, reliable, and inexpensive printing-telegraph, which will require no attendant at the receiving-station; and consists in the employment of two electro-magnets placed within the same circuit—one for rotating the type-wheel, the other for actuating the printing-hammer—in combination with a polarized relay, which forms an automatic switch that will instantly detect the direction of the current, and cause it, when traveling in one direction, to pass only through the electro-magnet of the type-wheel, and, when reversed so as to travel in the contrary direction, to pass only through the electro-magnet of the printing-hammer, which may thus be brought into operation, to produce the required impression upon the paper, by simply reversing the current at the proper time, no local battery being required at the receiving-station, as all the mechanism is operated by the current from the battery at the transmitting-station.

To enable others skilled in the art to understand and use my invention, I will proceed to describe the manner in which I have carried it out.

In the said drawings, A represents the frame-work of the instrument, to which is secured the electro-magnet B, which operates the type-wheel C, the periphery of which is provided with the required letters and characters. The armature *b* of the magnet B is attached to a lever, *c*, which is pivoted at *d*, and is bifurcated at its lower end, as seen in Figs. 1 and 2, the two arms *e f* carrying pawls *g h*, which engage with a ratchet-wheel, *i*, on the hollow shaft of the type-wheel C, which revolves on a stud, *k*, projecting from the frame-work.

It will be seen that the pawls *g* and *h* engage with the ratchet-wheel *i* on opposite sides, so that each vibration of the lever *c* backward or forward will rotate the type-wheel, which receives its supply of ink from the roll D, in a well-known manner.

E is the electro-magnet of the printing-hammer, which latter consists of a roll, *i*, secured to the outer end of a lever, G, which is pivoted at *j*, and carries the armature H of the magnet E. The strip of paper upon which the message is to be printed is led from a reel (not shown) over the roll *i*, upon which it is held with a sufficient degree of friction by a spring-arm, *l*, provided with an open slot, *m*, so as to allow the paper to be brought into contact with the edge of the type-wheel when the lever G is raised against the resistance of the spring 6 by the action of the electro-magnet E. The strip of paper is fed forward between the roll *i* and spring-arm *l* after each impression is made, so as to produce the required space between the letters, by means of a pawl, *n*, which, when the lever G descends, engages with a ratchet-wheel, *o*, Fig. 3, secured to the roll *i*, which is thus rotated at the required times, its edges 7 being roughened, so as to prevent the paper from slipping thereon.

The course of the current through the instrument, and the manner in which the latter is operated, will now be described, reference being had particularly to Figs. 1, 4, and 5.

I K are two batteries, so arranged that but one only is employed at a time.

Referring to Fig. 4, when the battery I is in use, the current passes (as indicated by black lines and arrows) from its copper pole *p*, by the wire *q*, to the key *r*; thence, by the wire *s*, to the electro-magnet of a polarized relay, L, which forms an automatic switch, by means of which the course of the current may be changed, as will be hereafter particularly described, it being well known that the passage of a current of electricity in one direction through the electro-magnet of a polarized relay will cause its tongue or lever *u* to be attracted to the pole N, and thereby brought into contact with the pin *v*, while the reversal of the current will cause it to be attracted to the pole N′, and brought into contact with the pin *w*, thereby opening different paths for the current, so that it may be made to pass through either one of the elec-

tro-magnets B or E, one of these magnets being excluded or cut out from the circuit while the current is passing through the other. The construction of this polarized relay, however, being well known, and forming no part of my invention, will not be further described.

The instant the current passes from the wire *s* through the polarized relay the tongue *u* will be attracted by the pole N and brought into contact with the pin *v*, when the current will pass by the wire *x* to the point 8, but as the contact is broken at *w* it cannot follow the wire *a′*, and consequently passes through the electro-magnet B, leaving it by the wire *c′*, and, instead of following this wire to the electro-magnet E, it takes a shorter course, viz., by the wire *d′* to the tongue *u*, thence through the contact-pin *v* to the wire *e′*, and thence to the ground and back to the wire *f′*, (also in connection with the ground,) whence it passes to the zinc pole of the battery I, thereby completing the circuit.

The circuit, after being completed as above described, may be alternately broken and closed by means of an ordinary transmitter, (not shown,) for the purpose of operating the armature *b*, and thereby rotating the type-wheel C, the mechanism connected with which is so arranged that the circuit requires to be closed and broken once in order to move the wheel C a distance equal to that between two successive letters or characters. This insures the circuit being open whenever a letter is brought into the position to allow of its impression being taken off upon the strip of paper.

When the type-wheel has been rotated (by operating the transmitter) until the desired letter has been brought into position beneath the roll *i*, the current is reversed by shifting the key *r* into the position seen in Fig. 5, which disconnects the battery I, and causes the current from the copper pole *g′* of the battery K to pass, by the wires *h′* and *f′*, to the ground-plate, thence to the distant ground-plate, entering the instrument by the wire *e′*. This reversal of the current causes the tongue *u* of the polarized relay to be instantly attracted to the pole N′ and brought into contact with the pin *w*, breaking the contact at *v*, as seen in Fig. 5.

The action of the polarized relay is so much quicker than that of an ordinary electro-magnet that the lever *u* is shifted from the point *v* to the point *w* before the electro-magnet B has time to act, and this magnet being cut out of the circuit as soon as the tongue *u* comes in contact with the pin *w*, the current will pass, as indicated by the red lines and arrows, Fig. 5, by the wires *h′ f′ e′ i′*, to the electro-magnet E of the printing-hammer, and thence, (instead of passing through the electro-magnet B,) by the shortest course, through the wires *c′ d′*, to the tongue *u*, thence, by the contact-pin *w* and wires *a′ x*, to the electro-magnet of the polarized relay, and, by the wire *s*, key *r*, and wire *k′*, to the zinc pole of the battery K, completing the circuit and causing the armature H to be attracted to the magnet E, raising the lever G and bringing the paper into contact with the letter on the type-wheel, as required. The key *r* is then moved back into the position seen in Figs. 1 and 4, which again reverses the current and causes it to take the course first described, through the electro-magnet B of the type-wheel, but not through the electro-magnet E, the armature of which ceases to be attracted when the lever G, with the roll *i*, is drawn down by the spring 6 and the paper fed forward to receive the next impression, as required, when the operation continues as before.

It will thus be seen that by the employment of a polarized relay, as above described, either one of the electro-magnets B or E may be brought into action, and the other cut out of the circuit at pleasure by the reversal of the current, which enables me to greatly simplify the construction of printing-telegraphs and reduce their cost.

The above-described invention is designed particularly for transmitting intelligence from a central station to a number of receiving stations included in the circuit, in which case no batteries or operators will be required at the receiving stations; but if messages are to be sent from each station, as well as received, then each instrument will require to be provided with a transmitting instrument, a battery, and an ordinary switch connected with a ground-wire.

What I claim as my invention, and desire to secure by Letters Patent, is—

The two electro-magnets B E, placed within the same circuit, one for operating the type-wheel, the other for operating the printing-hammer, in combination with a polarized relay which forms an automatic switch, whereby either one of the electro-magnets may be brought into action, and the other cut out of the circuit by the reversal of the current, substantially as and for the purpose described.

THOMAS A. EDISON.

Witnesses:

P. E. Teschemacher,

W. J. Cambridge.

2 Sheets—Sheet 1.

T. A. EDISON.

Electrical Printing Instrument.

No. 96,567. Patented Nov. 9, 1869.

Fig: 1

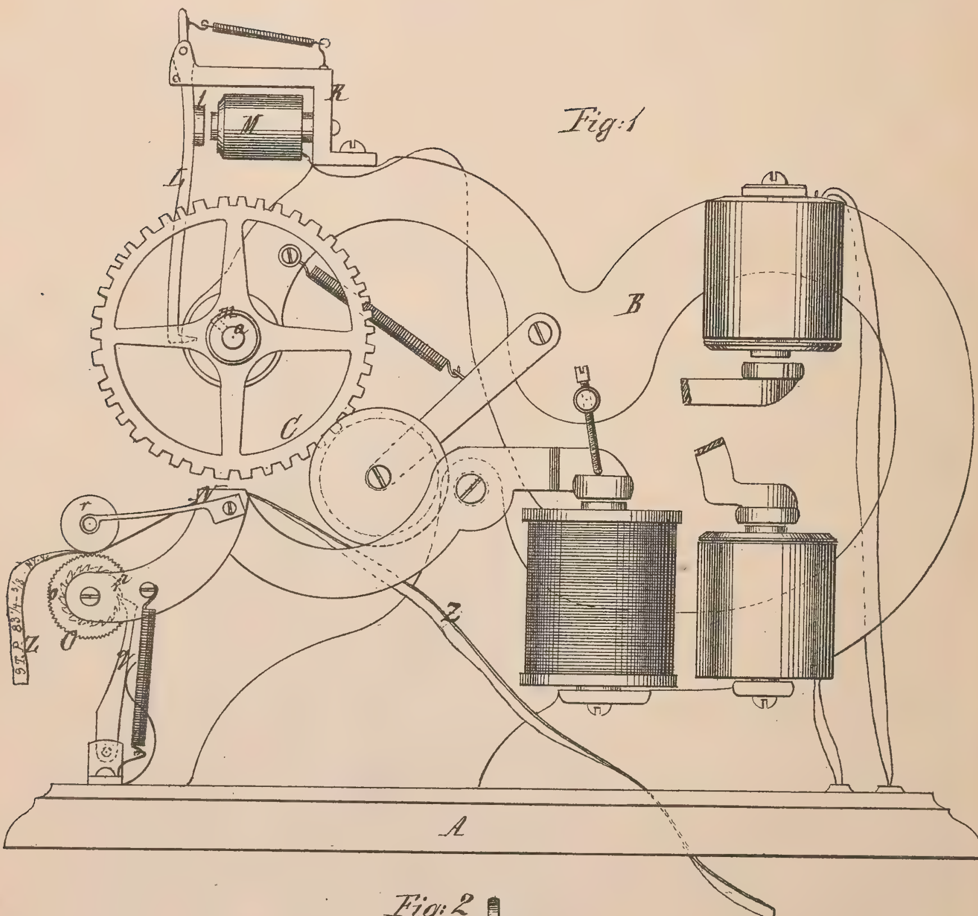
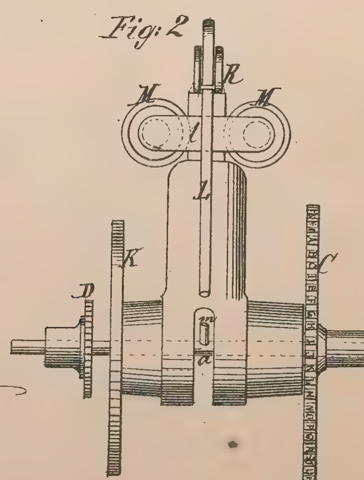


Fig: 2



Witnesses.

W. Hauff

R Langmeister

Inventor.

Thomas. A. Edison

2 Sheets—Sheet 2.

T. A. EDISON.

Electrical Printing Instrument.

No. 96,567. Patented Nov. 9, 1869.

Fig: 3.

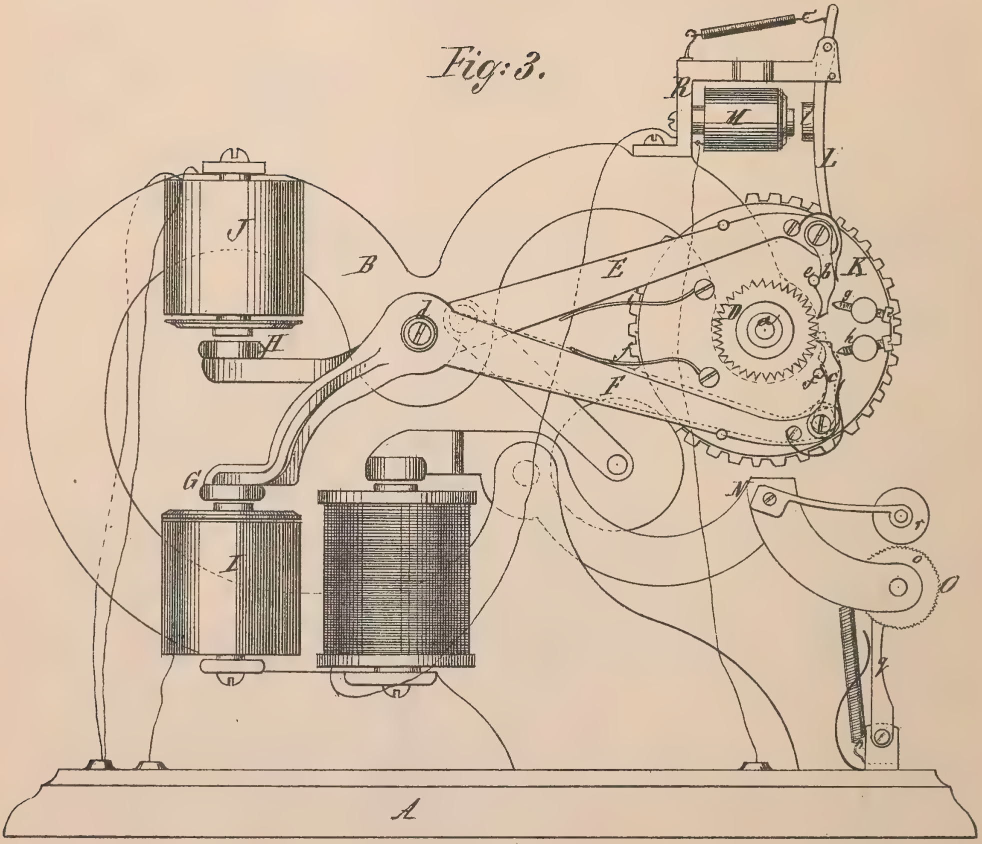


Fig: 4.

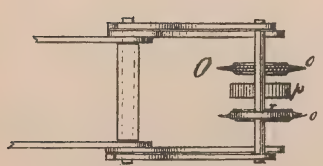
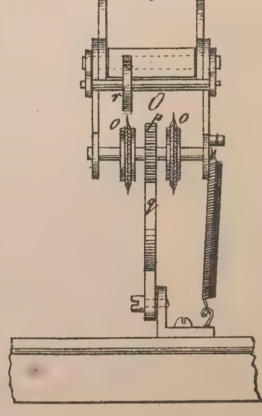


Fig: 5.



Witnesses.
W. Haiff
R. Baugmeister

Inventor.
Thomas A. Edison

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y., ASSIGNOR TO SAMUEL S. LAWS, OF SAME PLACE.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **96,567**, dated November 9, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city, county, and State of New York, have invented a new and useful Improvement in Electrical Printing Instruments; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which drawings—

Figure 1 represents a side elevation of this invention, showing the printing mechanism. Fig. 2 is a front view of the unison mechanism detached. Fig. 3 is a side elevation of my instrument, showing the mechanism for imparting to the type-wheel a step-by-step movement in either direction. Fig. 4 is a plan of the paper feed mechanism detached. Fig. 5 is a front view of the same.

Similar letters indicate corresponding parts.

This invention relates to certain improvements in that class of instruments for which Letters Patent were granted to S. S. Laws December 31, 1867, and March 24, 1868, and also described in an application for a patent filed by said S. S. Laws in the Patent Office January 4, 1869.

My present improvements consist in the arrangement of two dogs, pawls, or clicks pivoted to two armature-levers and acting on a star-shaped or double ratchet-wheel, in combination with stationary pins which are not connected with the ratchet or pawls and which act on the pawls in such a manner that by one set of pins the pawls are thrown out of gear with the ratchet, and by the other set of pins said pawls are locked in gear with the ratchet, and that by the action of the two pawls a uniform step-by-step movement can be imparted to the ratchet in either direction with ease and facility, the mechanism required for this purpose being exceedingly simple and not liable to get out of repair, and the type-wheel or ratchet is held in position, when at rest, by means of a graduated or adjustable friction instead of holding-pawls.

The invention consists, also, in the arrangement of a separate magnet in combination with the unison-lever in such a manner that the operator has absolute control over the unison-stops of all the instruments in the line without danger of disturbing the power of any of the other magnets.

In the drawings, the letter A designates a bed-plate, from which rises an arm, B, which may be cast solid with or otherwise rigidly attached to said bed-plate. The outer end of this arm B is bored out to form a bearing for a shaft, *a*, on one end of which is mounted the type-wheel C, while on its other end is mounted the ratchet-wheel D, said shaft being fitted in its bearings, so that it turns freely therein; but sufficient friction is secured by adjusting the position of the type-wheel to retain it in any position into which it may be brought. This friction may be obtained and regulated by the pressure of an adjustable spring upon the ratchet-shaft or some part carried around thereby.

The ratchet-wheel D is star-shaped or double-acting, and it is acted upon by two pawls or clicks, *b c*, which are pivoted to levers E F, extending from the armatures G H of two electro-magnets, I J. Said levers have a common fulcrum on the pivot or stud *d*, which is rigidly secured in the arm B, and their armatures and electro-magnets are arranged in such relation to said levers and to the ratchet-wheel that by alternately closing and opening the circuits through said electro-magnets the levers E F are caused to oscillate in opposite directions, and that by the action of one of the clicks the ratchet-wheel assumes a step-by-step movement in one direction, while the other click produces a step-by-step movement of the ratchet-wheel in the opposite direction. The position of the clicks, in relation to the teeth of the ratchet-wheel, is governed by two sets of pins, *e f*, *g h*, which are secured in a disk, K, that is rigidly attached to the end of the arm B. The pins *e* and *f* act on projections on the inner edges of the clicks *b* and *c*, and if the levers E and F are forced back, by the action of their springs *i* and *j*, said pins lift and hold the points of the clicks out of the path of the ratchet-teeth, and if either of the armatures is attracted and its lever caused to move, the pawls, being released of the pins *e* and *f*, are thrown in gear with the ratchet-teeth by the action of their springs, and the stop-pin *g* or *h* acts against the outside edge of the corresponding click and

holds it in gear and locks it with the ratchet-wheel, causing the same to stop at the distance of one tooth. The stop-pins *g* and *h* might be combined into one pin, serving the same purpose for each of the pawls. By this arrangement a step-by-step movement can be imparted to the ratchet-wheel, governed by the action of the stationary pins *e f g h* on the projections on the edges of said clicks, the friction of the type-wheel arbor being made sufficient to prevent the ratchet from moving when the lever-pawls are drawn back from the teeth.

It is obvious that the effect of the two clicks will be the same if they are made to engage with two ratchet-wheels on the same arbor, with teeth facing in opposite directions, such ratchets being a mechanical equivalent of the star-shaped ratchet shown in the drawings.

The electro-magnets I and J are fastened to the arm B, so that they straddle said arm, and easy access can be had to them and to their connections.

In order to throw all the instruments on a line in unison, a "unison-lever," L, is used, such as described in the application of S. S. Laws for a patent on printing-telegraph, filed in the Patent Office January 4, 1869. This unison-lever is hinged to a bracket, R, which is firmly secured to the main arm B, and to said lever is attached the armature *l* of a separate electro-magnet M, which is secured to the bracket R. The lower end of the unison-lever L forms a hook, (see Fig. 1,) and if the circuit through the electro-magnet M is closed, this hook is thrown in the path of a pin, *m*, which projects from the shaft *a*, (see Figs. 1 and 2,) so that the motion of said shaft is stopped as soon as the pin *m* comes in contact with the unison-lever. The pins *m* on the several instruments in a line are made to correspond in position to a certain type or character on the several type-wheels, and consequently by working all the instruments round in either direction until the several pins *m* are brought in contact with the several unison-levers, all the type-wheels are arrested in the same position and all the instruments are thrown into unison.

The object of working the unison-lever by a separate magnet is to enable the operator to control the position of said unison-lever without disturbing any other part of the mechanism, and particularly without diminishing the power of the main magnets, as when the unison-lever is operated by secondary armatures from either or both of the main magnets.

The strip of paper Z is carried through between the platen N and the type-wheel by the feed mechanism O. A roller, *r*, presses the strip of paper against one of the serrated rims or flanges *o* of the feed-wheel, and as the platen-lever oscillates, by the combined action of its electro-magnet and its detaching-spring the ratchet of the feed-drum acts against the click *g* and receives an intermittent rotary motion, so that for each oscillation of the platen-lever the strip of paper is moved a sufficient distance to make room for a subsequent impression. The pressing-roller *r* is situated on the inside of the feed-drum, and consequently the letters and characters printed on the strip of paper are not at all concealed by it while the strip passes through the feed mechanism, and said characters remain open to view from the time when they have been printed.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The stationary pins *e f g h*, in combination with the clicks *b c*, actuated by the armature-levers E F, and acting on the ratchet D, substantially as and for the purpose described.

2. The combination of a separate electro-magnet with the unison-lever L, substantially as set forth.

THOMAS A. EDISON.

Witnesses:

W. HAUFF,

E. F. KASTENHUBER.

T. A. EDISON.

Telegraph Switch.

No. 96,681.

Patented Nov. 9, 1869.

Fig. I.

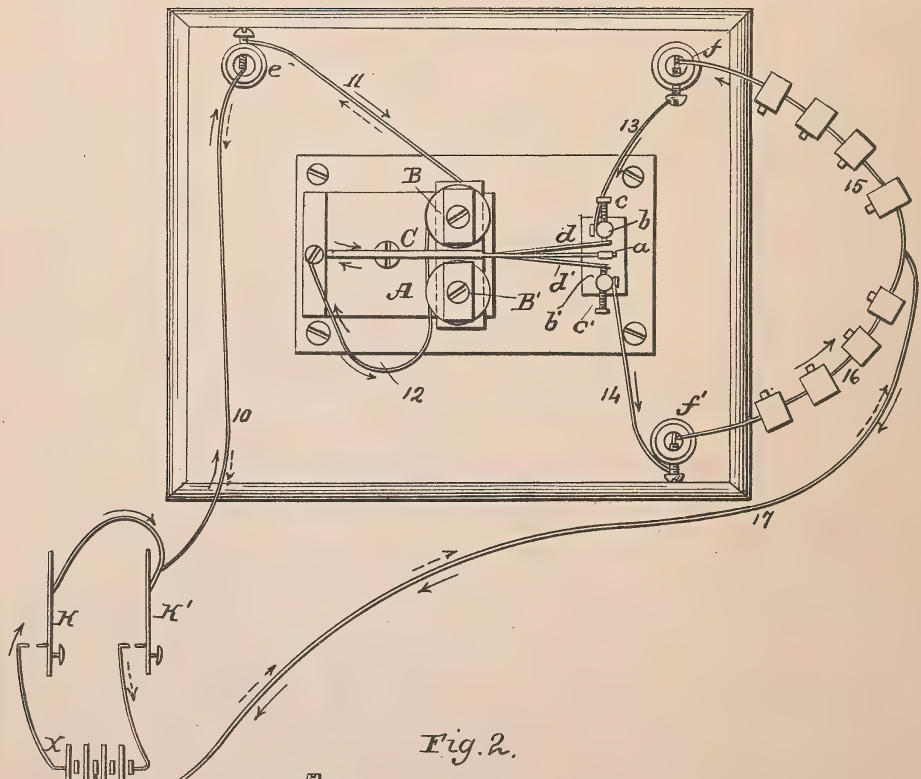
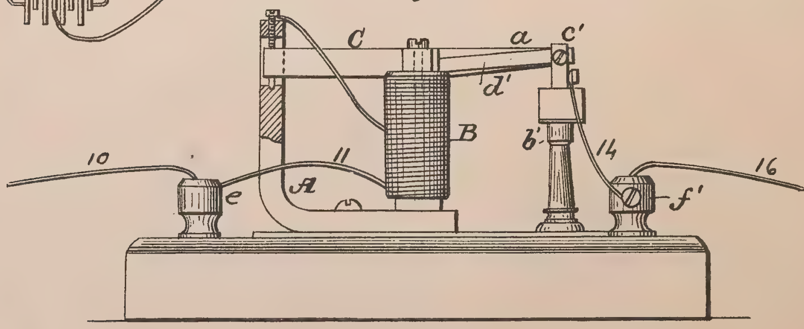


Fig. 2.



Witnesses:

W. Hardy

C. Wahlers

Inventor:

Thomas A. Edison

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y.

AUTOMATIC ELECTRICAL SWITCH FOR TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **96,681**, dated November 9, 1869.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city, county, and State of New York, have invented a new and useful Improvement in Automatic Electrical Switches; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1 represents a plan or top view of this invention. Fig. 2 is a longitudinal section of the same.

Similar letters indicate corresponding parts.

This invention relates to a certain novel arrangement of branches of one line of wire, in combination with a vibratory armature and its polarized switch-magnet, in such a manner that by passing a current through the coils of the switch-magnet in either direction, *i. e.*, positive or negative, the polarity of one of the poles thereof is neutralized, and the other is augmented and attracts and holds the vibratory armature, so that one of the branch wires, or sets of branch wires, is automatically switched out of the circuit, and the whole current is made to pass with undivided and undiminished force through the other branch wire or wires, whose connection is formed and maintained by the armature, and thus one single current, by reversal, can be made to pass, without any diversion or loss, indifferently through one branch wire, or set of branch wires, and another, at the will of the operator. For instance, one branch may be used for operating a type-wheel, and the other for printing therefrom in a printer, or for operating two different machines, or for effecting advance and retrograde movements in the same machine, and in a great variety of other ways, so that one circuit has, in many useful respects, the power of two ordinary ones.

The "polarized switch-magnet," which I use in carrying out my present invention, is similar to the "polarized relay," described in Letters Patent for a printing-telegraph, granted to me June 22, 1869, and numbered 91,527.

The polarized switch-magnet consists of a permanent magnet, A, bent in the form of the letter L. On the horizontal shank of this L-shaped magnet are secured the cores of two electro-magnets, B B′, while the upright shank of the permanent magnet forms the bearing for the vibrating armature C, which extends through between the ends of the electro-magnets B B′, and is so arranged that it can freely vibrate between said ends or poles and be attracted by either one or the other, as will be presently explained.

From the armature C extends an arm, *a*, through between the posts *b b′*, which carry adjusting-screws *c c′*, and to the sides of the arm *a* are secured weak springs *d d′*, so that if the armature is in a central position said springs will be in contact with the points of both the screws *c c′*; but as soon as the armature, attracted by either core of the electro-magnet, passes this central point in its transition, the contact between one of the springs *d* or *d′* and the corresponding screw *c* or *c′* will be broken.

It is obvious that if the upright shank of the permanent magnet represents the north pole, and the horizontal shank the south pole, the polarity of both soft-iron cores of the electro-magnet will also be south, while the polarity of the soft-iron vibratory armature will be north; but if an electric current is passed through the electro-magnet B B′, which, by its own action, would convert the core of B into the north pole, and the core of B′ into the south pole, the polarity of the core B received from the permanent magnet will thereby be neutralized and the polarity of the core B′ increased, and the armature C will be attracted by the core B′, and the spring *d* will be thrown and kept out of contact with its screw *c*, as long as the current operated with continues to be of the same polarity.

The polarized switch-magnet connects, by a wire, 10, with two keys, K K′, one of which will throw upon the line a positive and the other a negative current from the battery. The wire 10 is secured in the post *e* from which a wire, 11, extends to one end of the helix of the electro-magnet B B′. The other end, 12, of this helix is connected with and continues the circuit through the vibrating armature.

The posts *b b′*, which carry the adjusting-screws *c c′*, connect, by wires 13 and 14, with posts *f f′*, and from these posts extend the branch wires 15 and 16, which unite into one wire, 17, that leads back to the battery.

Instead of only two branches, 13 and 14, of the line 17, the currents at the points *c c′*, respectively, may be divided into a number of branches by arranging the contact-points and springs therefor.

Suppose the armature C so placed that the springs *d d′* will rest against both the points *c c′*, then a positive current (represented by full-line-arrows) from the battery will pass through the wires 10 and 11 to the electro-magnet B B′; thence through the wire 12 and the armature C, posts *b b′*, wires 13, 14, 15, 16, and 17 back to the battery. The armature will immediately be attracted by the core B′, the contact between the spring *d* and screw *c* will be broken, and the whole current passes from the armature through wires 14, 16, and 17 back to the battery. The branch wire 15 is thus entirely switched out of the circuit. In actual working under battery the armature C will always rest and remain against the pole to which it is last attracted till the current is reversed, when it will instantly pass to the opposite pole. The design of the springs *d d′* is to preserve the continuity of the circuit in the transition of the armature C from one pole to the other of the switch-magnet B B′ on reversal of the circuit. In such transition, as the double contact is only momentary, no effect will follow from it in the branch being switched out.

By depressing the key K′ the armature is attracted by the core B, the current (represented by the dotted arrows) is made to pass through the wires 13, 15, and 17, and the branch wire 16 is switched out of the circuit.

I distinctly disclaim in this present application for a patent everything shown and described in my Patent No. 91,527; but I will here remark that by my new arrangement I am enabled to cut either of the branch wires entirely out of the circuit, so that the current passes with undivided and undiminished force through the other branch wire or wires.

In the former case the current is taken from either magnet by a simple cut-off or shortened circuit. The magnet is left inactive by virtue of presenting greater resistance than the cut-off; but there is more or less flow of current-power through the continuous circuit of the magnet thus cut out.

In the present case the effect is produced, not by a cut-off, but by an absolute break of that branch of the circuit to be left out. The current is automatically absolutely switched from one branch or set of branches to another by simply reversing the poles of the battery. Besides, if, in the former case, the tongue or armature should strike between the points out of contact with either, the magnets, all being in the same circuit, would all act simultaneously. If the spring *d d′* be held in connection with both points *c c′*, the current of the line would divide between the branches and their magnets. In the former case, if both switch-points were connected at the same time, all the magnets would be entirely cut out.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An electro-mechanical switch, constructed substantially as described, in combination with two or more electro-magnets, placed in two or more distinct branches, 15 and 16, of the circuit containing said switch, all connected and operated substantially as described.

2. The springs *d d′*, in combination with the vibrating armature and the points *c c′*, for maintaining the continuity of the same circuit, substantially as set forth.

THOMAS A. EDISON.

Witnesses:

W. HAUFF,

E. F. KASTENHUBER.

2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 3,820. Reissued Feb. 1, 1870.

Fig: 1.

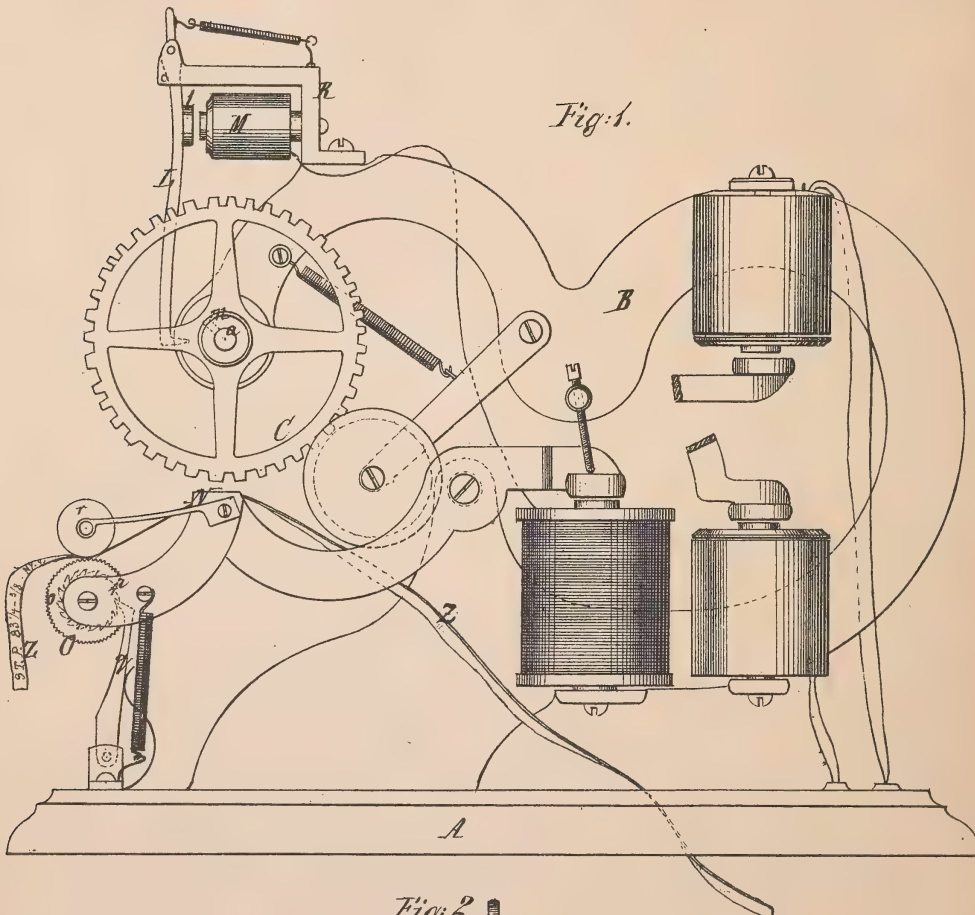
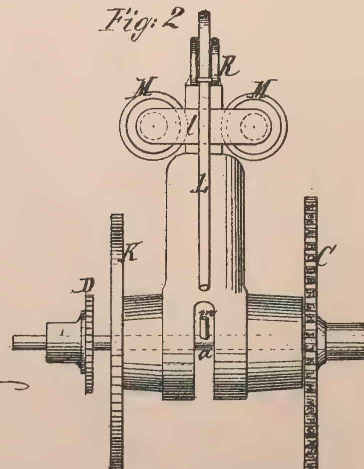


Fig: 2



Witnesses.

W. Hauff

R. Langmeister

Inventor:

Thomas A. Edison

N. PETERS. Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 3 820. Reissued Feb. 1, 1870.

Fig. 3.

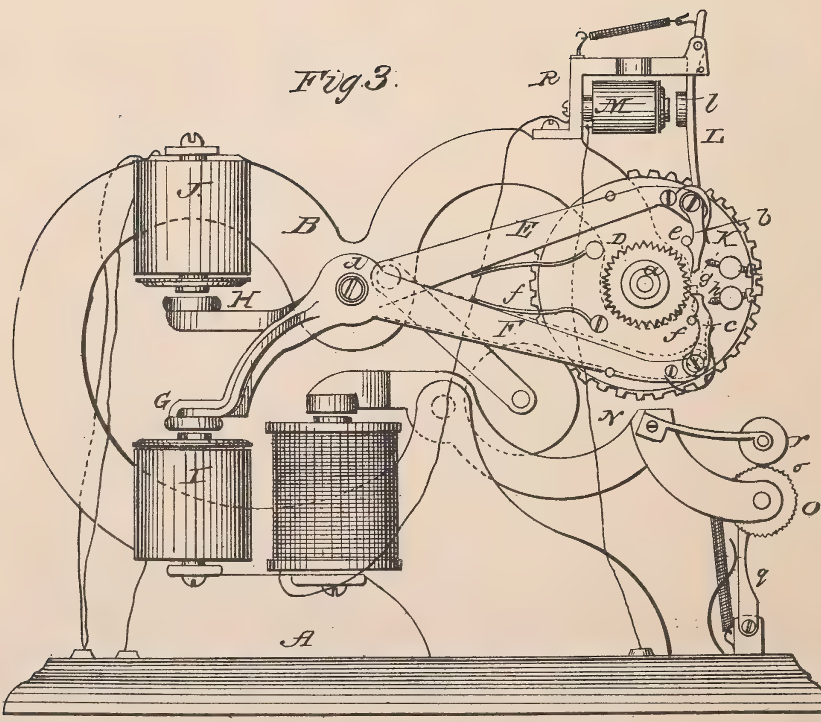


Fig. 5.

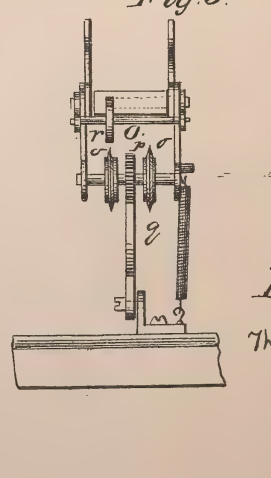


Fig. 4.

Witnesses
W. Hauff
R. Langmeurler

Inventor:
Thomas A. Edison

UNITED STATES PATENT OFFICE.

THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y., ASSIGNEES, BY MESNE ASSIGNMENTS, OF THOMAS A. EDISON.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 96,567, dated November 9, 1869; Reissue No. **3,820**, dated February 1, 1870.

To all whom it may concern:

Be it known that THOMAS A. EDISON, of the city, county, and State of New York, did invent a new and useful Improvement in Electrical Printing-Instruments; and the following is hereby declared to be a full, clear, and exact description thereof.

Figure 1 represents a side elevation of this instrument, showing the printing mechanism. Fig. 2 is a front view of the unison mechanism detached. Fig. 3 is a side elevation of the instrument, showing the mechanism for imparting to the type-wheel a step-by-step movement in either direction. Fig. 4 is a plan of the paper-feed mechanism detached. Fig. 5 is a front view of the same.

This invention relates to certain improvements in that class of instruments for which Letters Patent were granted to S. S. Laws, December 31, 1867, and March 24, 1868, and also described in an application for a patent filed by said S. S. Laws in the Patent Office, January 4, 1869.

Before this invention a type-wheel had been moved in either direction with a step-by-step motion, and a pawl or click had been used in other machinery to run beneath a stop and block the further movement of the ratchet-wheel.

In printing-telegraphs it is necessary to stop the character-wheel with great accuracy so that the impression may be properly made. To effect this object the stop that acts to block the pawl or click and type-wheel is adjustable, so as to compensate wear or inaccuracy of workmanship, and by making clicks to act in opposite directions by levers and electro-magnets the type-wheel can be moved progressively in either direction and stopped accurately, the clicks and stops limiting the movement of the lever, armature, ratchet-wheel, and character-wheel.

The invention consists in the arrangement of a separate magnet, in combination with the unison-lever, in such a manner that the operator has absolute control over the unison-stops of all the instruments in the line without danger of disturbing the power of any of the other magnets.

In the drawings, A designates a small bed-plate, from which rises an arm, B, which may be cast solid with or otherwise rigidly attached to said bed-plate. At the outer end of this arm B is a bearing for the shaft *a*, on one end of which is mounted the type-wheel C, while near its other end is the ratchet-wheel D, said shaft being fitted in its bearings so that it turns freely; but sufficient friction is provided to steady the type-wheel in any position into which it may be brought. This friction may be obtained and regulated by the pressure of an adjustable spring upon the ratchet-shaft or otherwise.

The ratchet-wheel D is star-shaped or double acting, and it is acted upon by two pawls or clicks, *b c*, which are pivoted to levers E F, extending from the armatures G H of two electro-magnets, I J. Said levers may have a common fulcrum on the pivot or stud *d*, and their armatures and electro-magnets are arranged in such relation to said levers and to the ratchet-wheel D that the levers E F are caused to oscillate in opposite directions when their respective magnets are charged, and by the action of one of the clicks the ratchet-wheel assumes a step-by-step movement in one direction, while the other click produces a step-by-step movement of the ratchet-wheel in the opposite direction.

The position of the clicks in relation to the teeth of the ratchet-wheel is governed by two sets of stops, *e f*, *g h*, which are secured in a disk, K, at the end of the arm B or other rigid support. The stops *e* and *f* act on projections on the inner edges of the clicks *b c*, respectively, and when the levers E and F are forced back by the action of their springs *i* and *j* said pins lift and hold the points of the clicks out of the path of the ratchet-teeth, and, if either of the armatures is attracted and its lever caused to move, the pawl, being released of the pin *e* or *f*, is thrown in gear with the ratchet-teeth by the action of its spring, and the stop-pin *g* or *h* acts against the outside edge of the click and holds it in gear and locks it with the ratchet-wheel, causing the same to stop at the distance of one tooth, and this is effected with accuracy by adjusting the stop *g* or *h*. The stop *g* or *h* might be combined into one pin, serving the same purpose for each of the pawls. By this arrangement a step-by-step movement can be imparted to the ratchet-wheel, and it is

governed by the action of the stops *e f g h* on the clicks, the friction applied to the type-wheel or arbor being sufficient to prevent the ratchet from moving when the lever-pawls are drawn back from the teeth.

It is obvious that the effect of the two clicks will be the same if they are made to engage with two ratchet-wheels on the same arbor with the teeth facing in opposite directions, such ratchets being a mechanical equivalent of the star-shaped ratchet shown in the drawings, and each ratchet-wheel, click, and adjustable stop acting in the manner aforesaid.

The pairs of electro-magnets I J may be fastened to the arm B, so that said arm comes between them, and easy access can be had to them and to their connections.

In order to throw all the instruments on a line in unison, a "unison-lever," L, is used, substantially such as described in the application of S. S. Laws for a patent on printing-telegraph, filed in the Patent Office January 4, 1869. This unison-lever is hinged to a bracket, R, which is firmly secured to the main arm B, and to said lever is attached the armature *l* of a separate electro-magnet, M. The lower end of the unison-lever L forms a hook, (see Fig. 1,) and if the circuit through the electro-magnet M is closed this hook is thrown in the path of a pin, *m*, which projects from the shaft *a*, (see Figs. 1 and 2,) so that the motion of said shaft is stopped as soon as the pin *m* comes in contact with the unison-lever. The pins *m* on the several instruments in a line are made to correspond in position to a certain type or character on the several type-wheels, and consequently by working all the instruments round in either direction until the several pins *m* are brought in contact with the several unison-levers all the type-wheels are arrested in the same position and all the instruments are thrown into unison.

The object of working the unison-lever by a separate magnet is to enable the operator to control the position of said unison-lever without disturbing any other part of the mechanism, and particularly without diminishing the power of the main magnets, as when the unison-lever is operated by secondary armatures from either or both of the main magnets.

The strip of paper Z is carried through between the platen N and the type-wheel by the feed mechanism O.

A roller, *r*, presses the strip of paper against one of the serrated rims or flanges *o* of the feed-wheel, and as the platen-lever oscillates by the combined action of its electro-magnet and its detaching-spring the ratchet of the feed-drum acts against the click *q* and receives an intermittent rotary motion, so that for each oscillation of the platen-lever the strip of paper is removed a sufficient distance to make room for a subsequent impression.

The pressing-roller *r* is situated on the inside of the feed-drum, and consequently the letters and characters printed on the strip of paper are not at all concealed by it, and said characters remain open to view from the time when they are printed.

What is claimed as the invention of THOMAS A. EDISON is—

1. The adjustable stop *g* or *h*, in combination with the click *b* or *c* and ratchet-wheel D, substantially as specified, whereby the position of the wheel D when blocked and stopped can be adjusted by the stop *g* or *h*, substantially as set forth.

2. The adjustable stop *g* or *h*, click *b* or *c*, ratchet-wheel D, and lever E or F, in combination with the type or character wheel C and an electro-magnet to give motion to the lever, substantially as and for the purposes set forth.

3. The clicks *b c*, levers E F, magnets I J, and ratchet-wheel D, in combination with the stops *e g f h*, substantially as specified, for moving a type or character wheel with a step-by-step motion in either direction, substantially as specified.

4. The unison-lever L, in combination with the type or character wheel and a separate electro-magnet, M, substantially as specified.

Dated December 28, A. D. 1869.

THE GOLD & STOCK TEL. CO.,
GEO. B. FIELD, *President*,
H. L. HOTCHKISS, *Secy*.

Witnesses:
CHAS. H. SMITH,
GEO. D. WALKER.

F. L. POPE & T. A. EDISON.

Printing Telegraph Apparatus.

No. 102,320. Patented April 26, 1870.

Fig: 1.

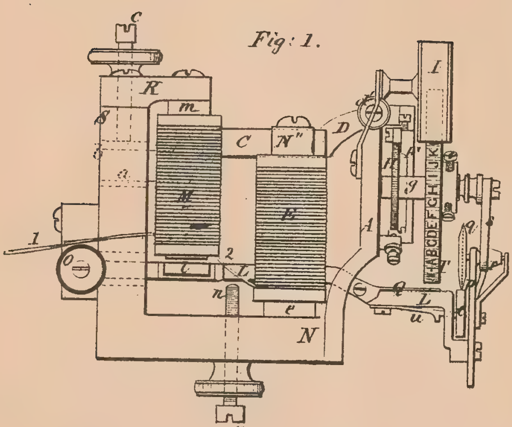


Fig 2

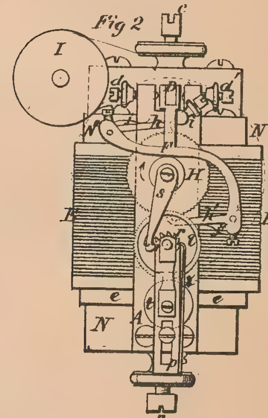


Fig 5

Fig 3.

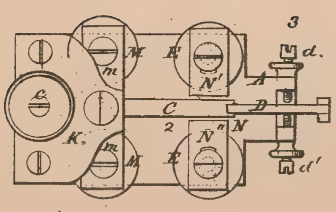


Fig: 4.

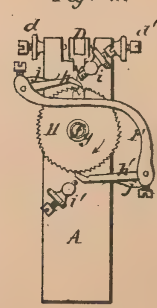
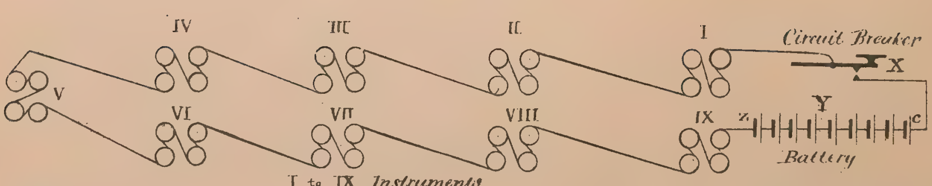


Fig 6



Witnesses:
M. M. Livingston
W. L. Beecher

Inventors:
Frank L. Pope
Thomas A. Edison

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, AND THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **102,320,** dated April 26, 1870.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and we hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

The nature of this invention consists in so arranging the parts of a telegraphic printing apparatus that the same is not only capable of receiving and recording communications in automatically-printed characters at a much greater speed than has been found practicable by the instruments in common use, but the same result is accomplished by the use of one wire without local batteries, which has heretofore required the use of two or more wires, or a local battery, or both, in connection with each instrument.

In the accompanying drawings, Figure 1 is a side elevation of the receiving apparatus. Fig. 2 is an end elevation of the same, the type-wheel being removed. Fig. 3 is a plan view of a portion of said apparatus. Fig. 4 is a detached view, showing the details of the escapement in said apparatus. Fig. 5 is a plan view of the slotted presser; and Fig. 6 is a skeleton diagram, showing the arrangement of a number of instruments located at different stations, and placed in the same electrical circuit, operated simultaneously in unison by a battery placed at one point in the circuit.

Similar letters refer to like parts in the different figures.

E, Figs. 1, 2, and 3, designates a perpendicular electro-magnet, composed of two cores of soft iron united below in the ordinary manner by a cross-bar, *e*, also of soft iron. The north pole of an angular bent permanent magnet, N S, is screwed to the cross-bar *e*, to which it communicates north polarity beyond the point of contact, and also to both the cores and poles of the electro-magnet E. The soft-iron tongue C is supported upon a pivot, *a*, in a slot, *b*, in the south end S of the permanent magnet N S, being secured in position by a screw, *c*, or otherwise, from which it receives south polarity. The tongue C is so placed that it may vibrate in a lateral direction between the north poles N′ and N″ of the electro-magnet E. It will therefore be seen that the north polarized ends N′ and N″ will each exert an equal attraction upon the south polarized tongue C when the same is equidistant from each, and that the same will be attracted and firmly held by either N′ or N″ when placed in close proximity or contact with one or the other. An arm, D, projects from the end of the tongue C, passing between screw-stops *d* and *d′*, by means of which screw-stops its lateral vibration is controlled and limited. The arm D is constructed of brass or other non-magnetic metal, in order to prevent the inductive magnetic action from extending beyond the poles N′ N″ of the electro-magnet E. The screw-stops *d* and *d′* are supported by a brass standard, A. Upon this standard is secured a shaft, *f*, Fig. 4, upon which is arranged a sleeve, *g*, carrying a ratchet-wheel, H, and a type-wheel, T, upon the circumference of which type-wheel are engraved such letters, numerals, or other characters as may be required. The characters on the type-wheel are supplied with ink by means of a fountain ink-roller, I, secured to a movable arm attached to the standard A. The vibrating arm D carries a curved bar, F, to the extremities of which are pivoted pawls *h* and *h′*, which act, respectively, at opposite points upon the circumference of the ratchet-wheel H, as shown in Figs 2 and 4. The movement of said pawls, and consequently that of the wheel H, is limited by the adjustable screw-stops *i i′*, by the end of the said pawls falling in the spaces of the wheel H and its upper beveled edge subsequently coming in contact with the stop *i* or *i′*, which may be adjusted so as to allow of any desired amount of movement of the said pawls *h* and *h′*, and the pawls are kept in contact with the teeth of the ratchet-wheel by springs *j j′*; but we will here remark that the pawls *h* and *h′* may be made of spring steel, and so arranged as to automatically bear in the interdental spaces of the wheel I, in which case the springs *j j′* may of course be dispensed with. By means of the above-described arrangement, the vibrations of the arm D may be caused to communicate

through the pawls a rapid intermittent rotary motion to the ratchet-wheel H, sleeve g, and type-wheel T in the direction shown by the arrow marked thereon. The screw-stops $d\,d'$ are so adjusted in reference to the stops $i\,i'$, that when the tongue C is actuated by a powerful current tending to bend or otherwise disarrange the pawls $h\,h'$, ratchet-wheel H, and their appurtenances, the slightest deflection of the arm D, after the pawls h or h' have come in contact with the stops i or i', will bring said arm D against one of the stops d or d', thereby relieving said pawls, ratchet-wheel, &c., from undue strain or pressure. The manner in which the vibration of the tongue C and arm D is made to revolve the ratchet-wheel H will be understood more clearly by reference to Fig. 4. Suppose the arm d to be moved from its position, as shown, toward the left, carrying with it the bar F and the pawls $h\,h'$. The pawl h' will engage with a tooth of the wheel H, and carry it forward in the direction of the arrow until its movement is arrested by the pawl coming in contact with the stop i'. At the same time the pawl h will slip over one tooth of the wheel without obstruction. When the arm D, bar F, and pawls $h\,h'$, are moved from left to right, the operation of the respective pawls is reversed, although the wheel H continues to be moved in the same direction as before. Each vibration of the arm D, either to the left or to the right, therefore advances the ratchet-wheel H the distance of one tooth. The apparatus for taking the impression after the type-wheel has been brought to the desired position, may be described as follows: M, Figs. 1 and 3, is an electro-magnet of the usual form, its poles being united by the cross-bar m, which is secured to a lug, K. This lug is firmly secured to the south end S of the permanent magnet N S. This lug is made of brass, or any other non-magnetic metal, for the purpose of cutting off the magnetic induction which would otherwise take place between the permanent magnet N S and the soft-iron cores of the electro-magnet M. The armature l of said electro-magnet is attached to a lever, L, one end of which is pivoted at O, and which passes through a slot in the standard A. The lever L is capable of a vertical movement upon O as its fulcrum, the extent of such movement being limited in one direction by the face of the type-wheel T, and in the other by the adjustable screw-stop n. To the extremity of the lever L is attached a slotted adjustable standard, p, carrying a wheel, q, with a sharp serrated edge. Upon the same shaft with said wheel q is a ratchet-wheel, r, actuated by a hook-shaped pawl, s, attached to the extremity of the type-wheel shaft f. A roller, t, of hard rubber, or other suitable material, is mounted upon a spring-axle, u, in such a manner as to be pressed firmly against the serrated edge of the wheel q. A ribbon of paper (not shown in the drawing) may be made to pass horizontally across the lever L, and beneath the slotted presser Q, shown in plan in Fig. 5, the edge of said paper passing between the serrated wheel q and the roller t in such a manner that the rotation of the wheel q will cause the ribbon to be drawn forward from right to left. The slotted presser Q serves to keep the paper from coming in contact with any portion of the type-wheel, except the letter of which the impression is desired. The two electro-magnets E and M are placed in the same electrical circuit, the connections being arranged as shown in Fig. 3.

The manner in which the above-described apparatus is actuated by means of electric currents is as follows: If a momentary current of electricity be sent from the positive pole of a battery through the electro-magnets E and M, its tendency would be to magnetize the pole N′ of the electro-magnet E "north," and the pole N″ "south;" but as both poles were previously north by the inductive influence of the permanent magnet N S, the effect of this current is to strengthen the north magnetism of N′, and to weaken or entirely destroy that of N″. The tongue C is therefore attracted to N′ with double force, and remains on that side after the cessation of the current, being still attracted by the pole N′, whose distance from C is now much less than that of N″. If, now, a momentary negative current is sent, this effect is reversed. The pole N″ in turn attracts the tongue, and it moves to that side, remaining until the polarity of the exciting current is again changed. Thus, by transmitting through the helices of the electro-magnet E a rapidly-alternating series of positive and negative currents, it will readily be seen that the tongue C, the arm D, and its attachments may be caused to vibrate to and fro with great rapidity, causing a correspondingly rapid revolution of the ratchet-wheel H and type-wheel T. It will be seen, therefore, that the type-wheel T may readily be brought to any required position simply by transmitting the requisite number of alternate positive and negative currents through the electro-magnet E. When the type-wheel T is thus brought to its proper position, the impression of the required letter is taken from the wheel, as follows:

The electro-magnet M, as heretofore explained, is in the same electrical circuit with E. In operating said electro-magnet advantage is taken of the fact that currents of such short duration as not to sensibly affect an electro-magnet of the ordinary construction will operate perfectly a polarized or combination magnet composed of permanent and electro-magnets placed in conjunction; and also that the attractive force of an ordinary electro-magnet is the same, whatever may be the polarity of the exciting current. Therefore, a succession of positive and negative currents may be sent through the wire 1 2 3, Figs. 1 and 3, of such short duration as not to affect in any manner the electro-magnet M, while by the action of the polarized electro-magnet E the type-wheel T may be revolved until the

the electro-magnet M, while by the action of the polarized electro-magnet E the type-wheel T may be revolved until the desired letter upon its circumference is brought opposite the impression-lever L. The duration of the final current is then prolonged regardless of its polarity until the electro-magnet M has time to act, when its attraction raises the lever L and brings the paper ribbon in contact with the type upon the wheel T, the same having been previously inked by the fountain-roller I. When the attraction of the electro-magnet M ceases the lever L returns to its original position. At the same time the hooked pawl *s* catches a tooth of the ratchet-wheel *r* and causes it, together with the wheel *q*, to revolve a short distance, thus drawing the paper ribbon forward and leaving a clear space in readiness for the next impression. A click, *x*, prevents the ratchet-wheel *r*, and consequently the wheel *q*, from revolving in the opposite direction.

The downward movement of the lever L may be assisted by a retracting-spring, if necessary.

It will be seen from the above description that this apparatus is actuated entirely by electro-magnetic power derived from the battery at the transmitting-station, without the assistance of local or secondary batteries or of mechanical power derived from any source other than the said battery at the said transmitting-station, and that any required number of such apparatuses may be placed at various points included in the same electric circuit, and operated simultaneously in unison by the action of a single battery placed at the transmitting-station. This will be more clearly understood by reference to Fig. 6, where we have given a skeleton diagram illustrating an arrangement of instruments in connection with a main battery and circuit-breaker, whereby an operator can at one point form a connection with a main battery, so as to complete an electric circuit in such manner that the current of said battery shall pass through as many instruments on a main line unprovided with local batteries as desired, and record simultaneously in printed characters at each instrument the same message. For instance, at a point lettered X there may be located a circuit-breaker of any suitable construction, and at the point lettered Y a main battery of sufficient power, or in lieu thereof a number of small main batteries located at such point or elsewhere in the main circuit that a current may be caused to pass from the main battery or batteries through the electro-magnets of instruments I II III, &c. Hence it will be understood without further explanation that a communication may be printed simultaneously at as many different stations as may be desired without the use of local batteries or of mechanism—such, for instance, as weights or springs—for operating each instrument. In such cases the action of such local batteries or mechanism is simply controlled by the action of the main electrical circuit.

It is obvious that another electro-magnet can be placed in the same circuit for effecting other useful purposes—such as striking a bell to call attention, &c.—which may be actuated by increasing the strength of the electric current which operates the printing mechanism.

It is also obvious that a local battery may be employed to bring into action a magnet not in the same circuit by insulating one of the stops *d d′* upon the standard A and connecting it with the local circuit in such manner that the rapid vibrations of the arm D will not allow it to remain in contact with the stop long enough to permit the local or secondary battery to charge its electro-magnet; but when the vibrations are made to cease by the action of the transmitting-operator, or otherwise, the arm D will remain in contact with the stop *d′* a sufficient time to allow the secondary electro-magnet to become charged.

We do not confine ourselves to the particular form and arrangement of parts shown in the drawing. There are numerous and well-known means of producing the vibratory movement of a lever by the use of alternate positive and negative currents in combination with a permanent and an electro magnet acting upon each other, and of applying the same to the movement of a type-wheel. Neither do we wish to confine ourselves to any particular method of producing or transmitting alternate positive and negative currents for the purpose specified.

We have shown in Fig. 6 the main line passing through both magnets of each instrument, this being the simplest and most convenient way of operating; but it is obvious that two main lines or wires may be employed, one running through one magnet of each instrument and the other through the other magnet of each instrument. In this latter case one line or wire is worked to revolve the type-wheel in proper position and the other to cause the impression.

We are aware that it is not new to construct and operate one or more automatic printing-telegraph instruments in one or more circuits which derive all their motive power from electro-magnets, or to operate such instruments by the use of a single battery placed at some convenient point, in conjunction with mechanical power applied to each instrument separately. We are also aware that automatic printing-telegraph instruments have been operated by means of two or more distinct main circuits, in which case the impression or printing magnet of each instrument is placed in one of the said circuits, and one or more magnets for operating the type-wheel of each instrument is placed in one or more additional main circuits, as shown and described in the patent granted to E. A. Calahan on the 21st of April, 1868.

We believe to be new the arrangement of a number of automatic telegraphic printing in-

struments of any suitable construction connected by a single electric circuit, all the parts of said instruments being actuated exclusively by electrical power derived from one or more main batteries placed in and forming part of such circuit, without the aid of local batteries.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination of a number of automatic printing-telegraph instruments arranged in one main circuit, and operating simultaneously in unison, when the electro-motive power used in operating the same is derived exclusively from one or more main batteries placed in such main circuit without the aid of secondary or local batteries, or of mechanism actuated by springs or otherwise, substantially in the manner and for the purpose set forth.

2. The combination of a polarized magnet with an electro-magnet placed in the same electrical circuit, and operated substantially as described, and for the purpose set forth.

3. The combination of the ratchet-wheel I, bar F, pawls *h h'*, stops *i i'*, and type-wheel T, arranged and operating substantially as and for the purposes herein specified.

4. The combination of an electro-magnet with the ratchet-wheel, bar, pawls, stops, and polarized magnet, substantially as and for the purposes herein specified.

5. The arrangement of the permanent magnet N S, polarized magnet E, electro-magnet M, tongue C, arm D, bar F, pawls *h h'*, stops *i i'*, springs *j j'*, ratchet-wheel H, type-wheel T, and standards A K, all constructed, arranged, and operating substantially as and for the purpose herein specified.

6. The roller *t*, serrated wheel *q*, pawl *s*, ratchet-wheel *r*, click *x*, and standard *p*, in combination with the polarized magnet E and the electro-magnet M, and their appurtenances, for the purpose set forth.

7. The screw-stops *d d'* upon the standard A, in combination with the type-wheel T, substantially as herein specified.

8. The arrangement of the tongue C in the slot *b* of the permanent magnet N S by means of a pivot, *a*, and screw *c*, whereby the inductive magnetic influence of the permanent magnet N S upon the tongue C is greatly increased, substantially as herein set forth.

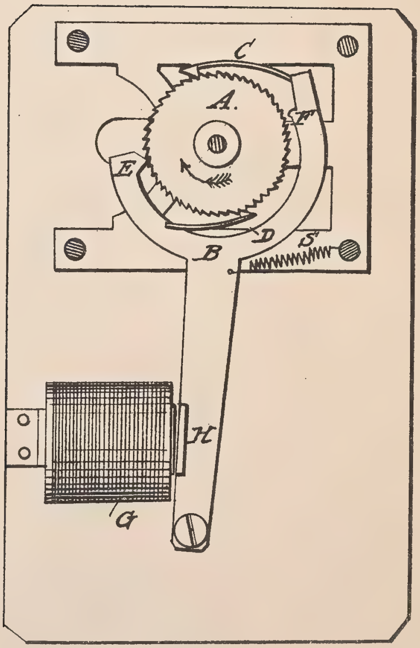
FRANK L. POPE.
THOMAS A. EDISON.

Witnesses:
M. M. LIVINGSTON,
T. B. BEECHER.

T. A. EDISON.

Printing Telegraph.

No. 103,035. Patented May 17, 1870.



Witnesses

M. M. Livingston

Frank L. Pope

Inventor

Thomas A. Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRO-MOTOR ESCAPEMENTS.

Specification forming part of Letters Patent No. **103,035**, dated May 17, 1870.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Electro-Motor Escapements; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, which forms part of this specification.

The object of this invention is to provide a novel and efficient means whereby an intermittent rotary motion in one direction may be communicated to a wheel and shaft by the vibrations of the armature of an electro-magnet, while at the same time, by simply suspending the action of the electro-magnet, the said wheel and shaft may be securely held at any desired point in its revolution.

In the accompanying drawing, which is a front elevation of my invention, A designates a wheel mounted upon a shaft, *a*, and provided with ratchet-shaped teeth upon its periphery. B is a forked lever, which is movable upon the pivot or arbor *b*, and is provided with two spring pawls or clicks, C and D, which engage with the teeth of the wheel A at two opposite points or sides of its periphery. E and F are stops secured to or formed upon the forked lever B, and these stops are so arranged as to act alternately at opposite points upon the teeth of the wheel A, as will be hereinafter described. G is an electro-magnet, the armature H of which is secured to the lever B. S is a retracting-spring, which retains the lever B in the position shown in the drawing when the electro-magnet G is not in action.

The manner in which this device operates is as follows: When a current of electricity passes through the coil of the electro-magnet G its attraction for the armature H causes the lever B to be moved toward said magnet. The pawl or click D engages with a tooth of the wheel A, and causes it to revolve in the direction shown by the black arrow until its motion is arrested by the stop E coming in contact with another of its teeth, as shown in the drawing. The click D at the same time slips over one tooth of the wheel A.

When the electric current is interrupted, the attractive force of the electro-magnet G is no longer exerted upon the armature H, and the spring S causes the lever B to return to its normal position.

During the latter movement a reverse action takes place by means of the click D and the stop F, the effect of which is to advance the wheel A still farther in the same direction as before. This action may be repeated indefinitely, and an intermittent rotary motion communicated to the wheel A by the vibration of the armature H of the electro-magnet G.

When the lever B is at rest at either extremity of its vibration, one of the stops, E or F, rests between two teeth of the wheel A, thus holding it in the desired position until the lever is again moved.

The ratchet-wheel and escapement, when arranged as described, may be placed upon a shaft midway between the bearings of said shaft without necessarily being placed close to the frame in order to accommodate the stops. In the construction and operation of printing and dial telegraphs this is often a great advantage.

This improved escapement has several important advantages over those employing rigid pawls or clicks pivoted or hinged to the lever of the armature, and having screw-stops attached to the frame. For instance, the jarring and vibrating caused by the rapid movements of the lever in such above-referred-to devices has a tendency to continually loosen the pivots or screws by which the pawls or clicks are attached to the lever, and the same effect is produced upon screw-stops when arranged upon the frame, thereby throwing the apparatus out of proper adjustment.

By the use of spring pawls or clicks permanently attached to the lever, and by arranging the stops upon the lever so as to form a part thereof, as in my present escapement, all danger of the apparatus being thrown out of adjustment by the loosening of any of the parts is entirely obviated.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of the click C, stop E, lever B, and toothed wheel A with the electro-magnet G and armature H, substantially as and for the purposes herein specified.

2. The combination of the click D, stop F, lever B, and toothed wheel A with the electro-magnet G and armature H, substantially as and for the purposes herein specified.

3. The combination, with an electro-magnet, G, of a vibrating lever, B, provided with the stops E F, one or both, and clicks C D, one or both, arranged and operating substantially as herein specified.

4. The combination of the clicks C and D, stops E and F, lever B, spring S, toothed wheel A, armature H, and electro-magnet G, substantially as and for the purpose herein specified.

THOMAS A. EDISON.

Witnesses:

M. M. LIVINGSTON,

FRANK L. POPE.

2 Sheets--Sheet 1.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

103924. PATENTED JUN 7, 1870.

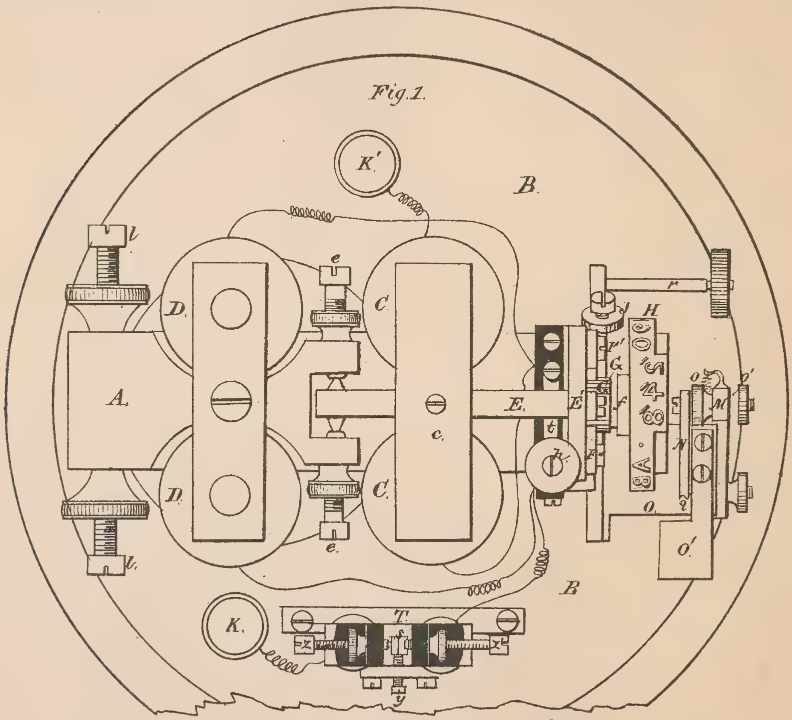


Fig. 1.

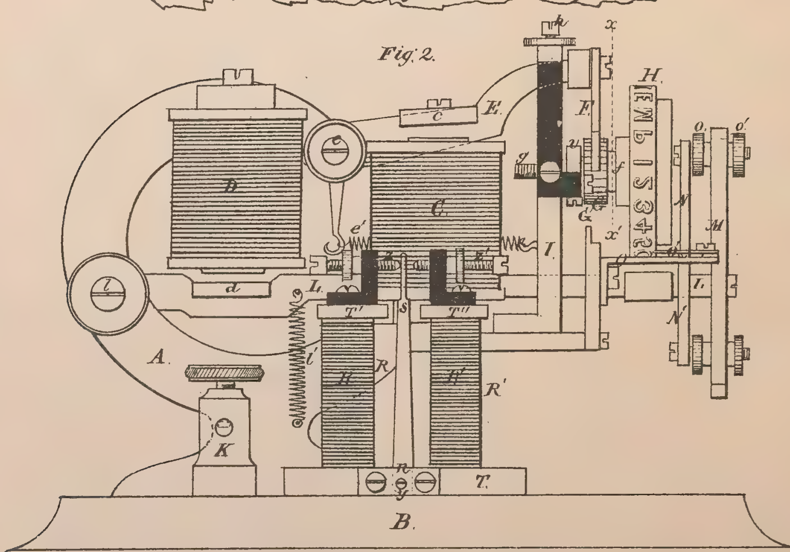


Fig. 2.

Witnesses.
M. M. Livingston
T. B. Beecher

Inventors.
Frank L. Pope
Thomas A Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets--Sheet 2.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

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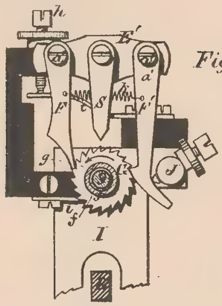


Fig. 3.

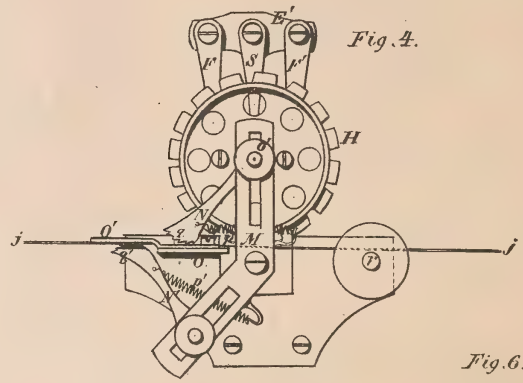


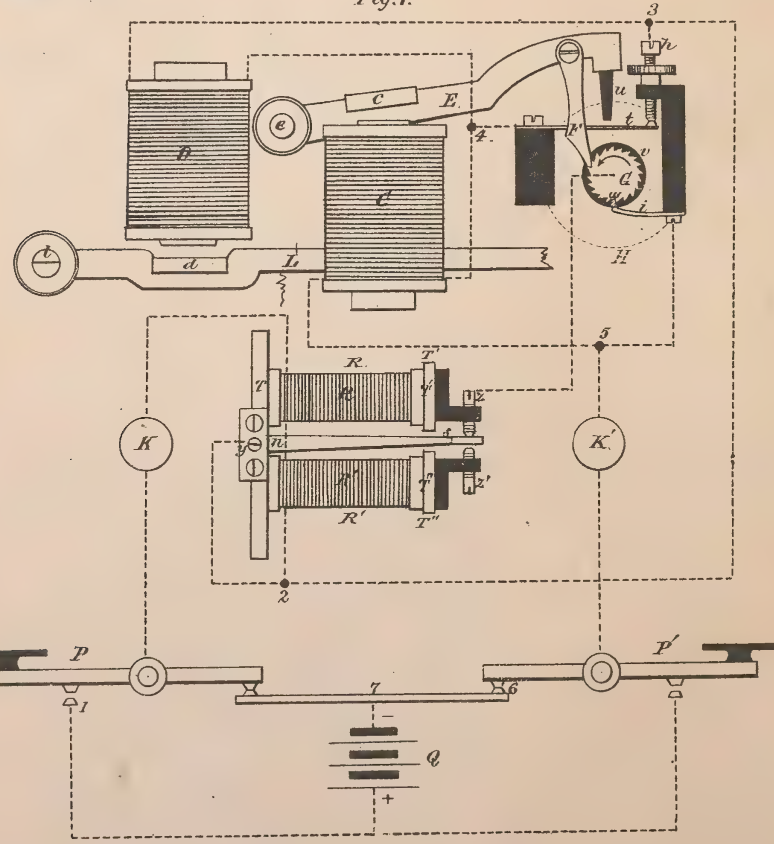
Fig. 4.

Fig. 5.

Fig. 6.

123 · 1/2 · 5 8

Fig. 7.



Witnesses; [illegible]

Inventors; Frank L. Pope

Thomas A Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, AND THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **103,924**, dated June 7, 1870.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

The object of this invention is to furnish a telegraphic instrument, by means of which communications may not only be recorded automatically in printed characters at one or more distant points, at the pleasure of the transmitting operator, but by which this result may be accomplished with greater certainty, and in a much more simple manner, than by the apparatus hitherto used for this purpose.

The principal features of this improvement relate, first, to the placing of the electro-magnet which rotates the type-wheel, in the same electrical circuit with a second electro-magnet which operates the printing mechanism, and so arranging them, in connection with an electrical cut-off of a novel construction, that the printing mechanism can only act after the type-wheel has been brought to its desired position; second, to the use of an electrical cut-off, which we term the unison cut-off, and by means of which any number of printing-telegraph instruments may be brought into correspondence with the transmitting-instrument at the pleasure of the transmitting operator; third, to the use of an electro-magnetic switch of peculiar construction, which is employed for the purpose of placing the unison cut-off in circuit, and which may also be made useful for other purposes in connection with printing-telegraph instruments; fourth, to an improved paper-feeding mechanism for printing-telegraph instruments; fifth, to the placing of certain duplicate figures or characters in a peculiar position upon the type-wheel, for purposes hereinafter specified.

The arrangement of the various parts of this invention will be more fully understood by reference to the accompanying drawings, in which—

Figure 1 represents a plan view of the receiving and recording apparatus. Fig. 2 is a side elevation of the same. Fig. 3 is a sectional front view of a portion of the apparatus taken through the line $x\ x'$, Fig. 2. Fig. 4 is a detached front view, showing the device for moving the paper forward beneath the type-wheel. Fig. 5 is a sectional view, showing the details of the unison cut-off. Fig. 6 illustrates the manner in which numbers and fractions are printed by the apparatus. Fig. 7 is a theoretical diagram, designed to show the electrical connections of the various parts of the apparatus, and their relations to each other, whereby the desired results are obtained.

Similar letters and marks of reference indicate like parts in the different figures.

A (see Figs. 1 and 2) designates a metallic frame or standard, which is firmly secured to the pedestal or base B, and which serves as a support to the different portions of the receiving-instrument. An electro-magnet, C, is secured, preferably, in an upright position upon the lower portion of the frame A, and a second similar electro-magnet, D, is placed in a preferably inverted position upon the upper portion of the said frame. The armature *c* of the electro-magnet C is attached to a lever E, which moves upon pivots *e e* fixed in the upper extremity of the frame A. A pawl, F, Figs. 1, 2, 3, and 4, is pivoted at *a* to the cross-head E′, at or near the end of the lever E. This pawl engages with the teeth of a ratchet-wheel, G, as shown in Fig. 3. The ratchet-wheel G, and also the type-wheel H, are mounted upon a sleeve, *f*, which revolves upon a stationary spindle, *g*, projecting from the standard I, which latter is supported by the frame A. This arrangement will be clearly understood by reference to Figs. 1, 2, and 3. The cross-head E′, Fig. 3, is also provided with a second pawl, F′, which is pivoted at *a′*, and is provided at one end with a hook, which acts upon the opposite side of the wheel G. A stop, S, is permanently secured to the cross-head E′ midway between the pawls F and F′. The pawls F and F′ are kept in contact with the face of the wheel G by means of a spiral spring, K, or in any other suitable manner.

By reference to Fig. 3 it will readily be understood that a downward movement of the lever E and the cross-head E′, caused by the

attraction of the electro-magnet C, will cause the pawl F to engage with a tooth of the ratchet-wheel G, and cause the latter to rotate the distance of half the depth of a tooth in the direction of the black arrow, when its movement is arrested by the stop S coming between the teeth of the wheel G. The pawl F′ has, meantime, passed one tooth of the wheel G, and when the lever E returns to its former position it engages with the said tooth, and rotates the wheel the distance of half the depth of a tooth farther, when its motion is arrested by the stop J. Thus each movement of the lever E in both directions advances the wheel G one tooth in the direction of the black arrow, and an intermittent rotary motion is imparted to said wheel G by the vibrations of the lever E under the influence of the electro-magnet C. This intermittent rotary motion is imparted to the sleeve *f* and the type-wheel H.

The ratchet-wheel G is provided with a number of teeth corresponding to the number of letters, figures, or characters upon the circumference of the type-wheel G, so that the latter may be brought to any desired position by transmitting the appropriate number of electrical pulsations through the electro-magnet C, each pulsation advancing the wheel G one tooth, and the type-wheel H one character, through the medium of the armature *c*, lever E, and pawl F, as hereinbefore explained.

The electrical connections between the different portions of the apparatus are only partially seen in Figs. 1 and 2, but are fully shown in Fig. 7, which will be hereinafter explained.

The apparatus for taking the impression of any desired letter, when the type-wheel has been brought to the proper position, is constructed and operates as follows:

Underneath the electro-magnet D, Fig. 2, is a horizontal lever, L, to which its armature *d* is attached. This lever is capable of a slight vertical motion upon the pivots *l l*. The lever L passes between the helices of the electro-magnet C, and through an aperture in the standard I. The strip of paper *j j*, Fig. 4, passes over the extremity of the lever L and underneath the type-wheel H. When the electro-magnet D becomes sufficiently excited by the passage of the electrical current, its attraction will be exerted upon the armature *d*, thereby raising the lever L and bringing the strip of paper *j j* forcibly in contact with the character upon the type-wheel H, which is over it at the time. The characters upon the type-wheel having been previously inked by means of an ink-roller, or other suitable device, an impression of the said character is made upon the paper. Upon the cessation of the electric current in the coils of the electro-magnet D, the lever L is drawn back to its original position by means of the spring *l*′.

The device for moving the paper forward, after each impression has been made, is constructed and operates as follows:

Upon the end of the lever L there is secured a slotted bar, M, Figs. 1, 2, and 4, which moves vertically with said lever L. To the upper portion of this bar there is attached a feeder, N, by means of adjustable set-screws *o* and *o*′, which allow of its being secured at any desired point upon the bar M. The feeder N is placed in an inclined position, as shown in Fig. 4, its lower extremity being serrated, or provided with spurs *q*′, and resting upon the strip of paper *j j*, which, at that point, is supported by the bed-plate O. The feeder N is kept in contact with the paper by means of a spiral spring, *q*. A second feeder, N′, is attached in the same manner to the lower part of the bar M, so as to rest against the under side of the strip of paper at *q*′, which paper passes underneath the plate O′, as shown in Figs. 1, 2, and 4.

By an inspection of Fig. 4 it will be understood that, when the lever L′ and its bar M descends after an impression has been made, the lower end of the feeder N is thrust to the left, and the paper is pushed forward by its spurs *q*. When the lever L is again moved upward the feeder N′ in the same manner advances the paper still farther to the left. By this arrangement the feeders N and N′ may be so adjusted that a comparatively slight vertical movement of the lever L will cause a considerable horizontal movement of the strip of paper *j j*, and the amount of this movement may be regulated at pleasure by altering the position of the set-screws *o* and *o*′ upon the bar M.

The manner in which the several parts of the apparatus are electrically connected and operated will be understood by reference to Fig. 7, which is a theoretical diagram, showing the various parts heretofore described in relation to each other, and with their proper electrical connections.

In Fig. 7, Q represents a voltaic battery of any suitable construction, the positive and negative poles of said battery being distinguished in the drawing by the signs + and —. P is a key or circuit-breaker, which may be of any suitable construction. The battery Q and key P it is to be understood are situated at the transmitting-station. By means of the circuit-breaker P a series of successive pulsations may be transmitted through the conducting-wires and the electro-magnets of the receiving apparatus. Starting from the positive pole of the battery Q, the circuit may be traced to the anvil 1 of the key *p*; thence through the electro-magnet R R′, for purposes which will be hereinafter explained, to the point 2, and thence to the point 3. From the point 3 to the point 4 two routes are open to the current—one through the helices of the electro-magnet D, and the other through the screw *h* and flat spring *t*. The latter route being much the shortest, and offering little or no resistance to the passage of the current, the electro-magnet D will not be perceptibly affected by the passage of the current as long as the branch circuit through *h* and *t* remains uninterrupted. From the point 4 the current passes through

the helices of the electro-magnet C to the point 5, and thence, by 6 and 7, to the other pole of the battery Q. When the lever E is drawn down by the action of the electro-magnet C, an insulated pin, *u*, Fig. 7, strikes the spring *t* just before the movement of the former is arrested, and breaks the electrical contact between it and the screw *h*. The entire current is therefore momentarily thrown through the helices of the electro-magnet D at each vibration of the lever E; but when these vibrations are performed with considerable rapidity, the electro-magnet D is not kept in circuit long enough to become completely magnetized. When the circuit remains closed for a longer time, the electro-magnet D becomes fully magnetized and attracts its armature *d*, thereby raising the lever L and bringing the strip of paper *j j* against the type upon the type-wheel H.

It will therefore be understood from the above explanation that the impression of any given character upon the type-wheel H may be produced upon the paper *j j* by an operator stationed at a distant point, as, for example, at P, (see Fig. 7,) simply by transmitting the proper number of electrical impulses of short duration by means of a properly-constructed circuit-breaker, which will cause the type-wheel H to revolve without sensibly affecting the impression device. When the desired character is brought opposite the impression-lever L the duration of the final current is prolonged, and the electro-magnet D becomes fully magnetized, and therefore an impression of the letter or character upon the paper is produced, in the manner hereinbefore described.

When a number of automatic printing-telegraph instruments is situated at different points, and operated simultaneously in one circuit, it is desirable that some suitable means may be provided whereby the transmitting-operator may be enabled to bring the type-wheels of the several receiving or recording instruments into correspondence at pleasure.

This is effected by the following device: Upon the sleeve *f*, which carries the type-wheel H and ratchet-wheel G, is secured a collar, *v*, Figs. 2, 5, and 7. This collar is composed of some suitable insulating material. We will here observe that in all the figures the non-conducting material employed to insulate one portion of the apparatus from another is represented in deep black color. A metallic spring, *i*, fixed upon an insulating support, Figs. 5 and 7, presses against this collar as it revolves. A metallic pin or stud, *w*, is inserted into the sleeve *f*, passing through the insulating collar, as shown in Figs. 5 and 7, in such a manner as to form an electrical connection between the sleeve *f* and the spring *i* whenever the pin or stud *w* is brought in contact with said spring by the revolution of the sleeve *f*. This arrangement is clearly shown in Figs. 5 and 7. By reference to Fig. 7, in which the electrical connections are shown in dotted lines, it will be understood that this connection forms a short circuit between the point 2 and the point 5, cutting off nearly all the electric current from the electro-magnets C and D, and thereby arresting their action. This short circuit may be brought into action at the pleasure of the transmitting operator, by means of the device we will now describe. R R′, Figs. 2 and 7, designate the helices of a small electro-magnet whose poles are shown at T′ and T″, the opposite ends of the cores being screwed into the soft-iron bar T. A permanently-magnetized steel-bar, *n s*, is pivoted to the bar T at *y*, its opposite extremity being free to vibrate between the screws *z* and *z*′. In consequence of a well-known law of magnetic action, when a current from the battery Q passes through the helices of the electro-magnet R R′ in one direction, the south end *s* of the magnetic bar *n s* will be attracted by T′ and repelled by T″, while a current in the opposite direction will produce the reverse effect. One pole of the polarized bar *n s* being in magnetic contact with the mass of soft iron formed by the bar T and its attachments, its magnetism cannot be weakened or reversed, as is often the case with magnetized armatures, which are not in magnetic contact with the soft iron of the electro-magnet. From this explanation, and by reference to Fig. 7, it will be readily understood that the transmitting operator, by employing the circuit-breaker P′ instead of P, can send a series of electrical pulsations through the circuit in the opposite direction, which will cause the south end *s* of the bar *n s* to be deflected toward T′, so as to come in contact with the stop *z*. As it is a matter of indifference in which direction the current passes through the electro-magnet C, in order to operate it, the type-wheel of each instrument will continue to revolve by its action, as usual, until the pin or stud *w* comes in contact with the spring *i*, when a short circuit will be formed from 2, Fig. 7, through *n*, *s*, and *z*, to the metallic frame of the instrument, and thence through sleeve *f*, pin or stud *w*, and spring *i* to the point 5, and thence by the usual route. The principal part of the current will take the shorter route just described, and the action of the electro-magnet C, and consequently the movement of the type-wheel H, will be arrested. Each instrument in the circuit will therefore stop automatically at the same point in the revolution of the type-wheel H and sleeve *f*. When this has been accomplished the electric current is again reversed, and the operation of the apparatus proceeds as usual.

When the instrument hereinbefore described is intended to be used for reporting quotations of markets, &c., wherein the amounts to be represented fluctuate by eighths of one per cent., three duplicate figures or characters are placed upon the periphery of the type-wheel H in such a position as to impress themselves upon the strip of paper lower than the line of the other figures or characters upon the wheel,

which may be used, in combination with the ordinary numerals, to indicate fractional quantities. The arrangement of these characters upon the type-wheel is shown in Fig. 1, and the manner in which their impressions upon the paper are combined with those of the numerals to represent fractional quantities is shown in Fig. 6.

By means of this device, the total number of characters upon the type-wheel may be considerably reduced and the speed of transmission correspondently augmented.

It is obvious that letters as well as other characters may be placed upon the type-wheel, in a different circumferential plane, in the same manner as the figures just referred to, and in such cases the letters, figures, or characters in the one circumferential plane would be opposite blank spaces in the other circumferential plane, and hence no two letters, figures, or characters would be in the same axial plane.

This arrangement of letters, figures, or characters upon the type-wheel of a printing-telegraph we believe to be new.

We do not claim, distinctively, the placing of an electro-magnet for operating the type-wheel of a printing-telegraph instrument in the same circuit with the electro-magnet that actuates the printing mechanism; nor do we claim, in general, the use of a device for bringing the transmitting and receiving apparatus into unison from the transmitting-station, as this is shown in the patent granted to Charles Kirchof, April 15, 1856, and also in the patent granted to S. S. Laws, January 25, 1870.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a printing-telegraph instrument, the arrangement of two electro-magnets in the same electrical circuit, one being employed to rotate the type-wheel and the other to actuate the printing mechanism, when the action of the latter is controlled by that of the former, by means of a branch or short circuit and a mechanical cut-off or its equivalent, constructed and operated substantially as described.

2. An improved cut-off, which we term an electrical unison cut-off, whereby, at a given point in the revolution of a ratchet or type wheel, a shunt or branch circuit may be brought into action, and the electrical current diverted from the electro-magnet controlling the movement of the said ratchet or type wheel, so that the said movement may be arrested at such given point, the same being constructed and operated substantially as specified.

3. The electro-magnet R R′ and soft-iron bar T, in combination with a polarized steel bar, *n s*, so arranged that said steel bar will be in magnetic contact with the said soft-iron bar, substantially as herein specified.

4. The bar M, feeders N and N′, (either or both,) spurs *q* and *q′*, (either or both,) bed-plates *o* and *o′*, (either or both,) combined, arranged, and operating substantially as described, and for the purpose specified.

5. The combination of the lever E, pawls F and F′, stops S and J, and ratchet-wheel G, arranged and operated substantially as described.

6. The combination of the pawl F, stop S, and ratchet-wheel G, substantially as and for the purpose specified.

7. The electro-magnets R R′, soft-iron bar T, and polarized-steel bar *n s*, in combination with the spring *i*, insulated collar *v*, and pin or stud *w*, in the manner described, and for the purpose specified.

8. The combination, with an electro-magnet, in a telegraphic printing apparatus, of a type-wheel whose periphery is provided with integral numbers so arranged upon said type-wheel that fractions of numbers may be printed upon the paper, thereby decreasing the number of characters upon the type-wheel, and insuring great rapidity in recording, substantially as herein shown and described.

9. In a printing-telegraph, a type-wheel provided with letters, figures, or characters, which are arranged in two different lines drawn around the periphery of said wheel, and in such manner that the said letters, figures, or characters in the one line shall be opposite blank spaces in the other line, substantially as herein specified.

FRANK L. POPE.
THOMAS A. EDISON.

Witnesses:
M. M. LIVINGSTON,
T. B. BEECHER.

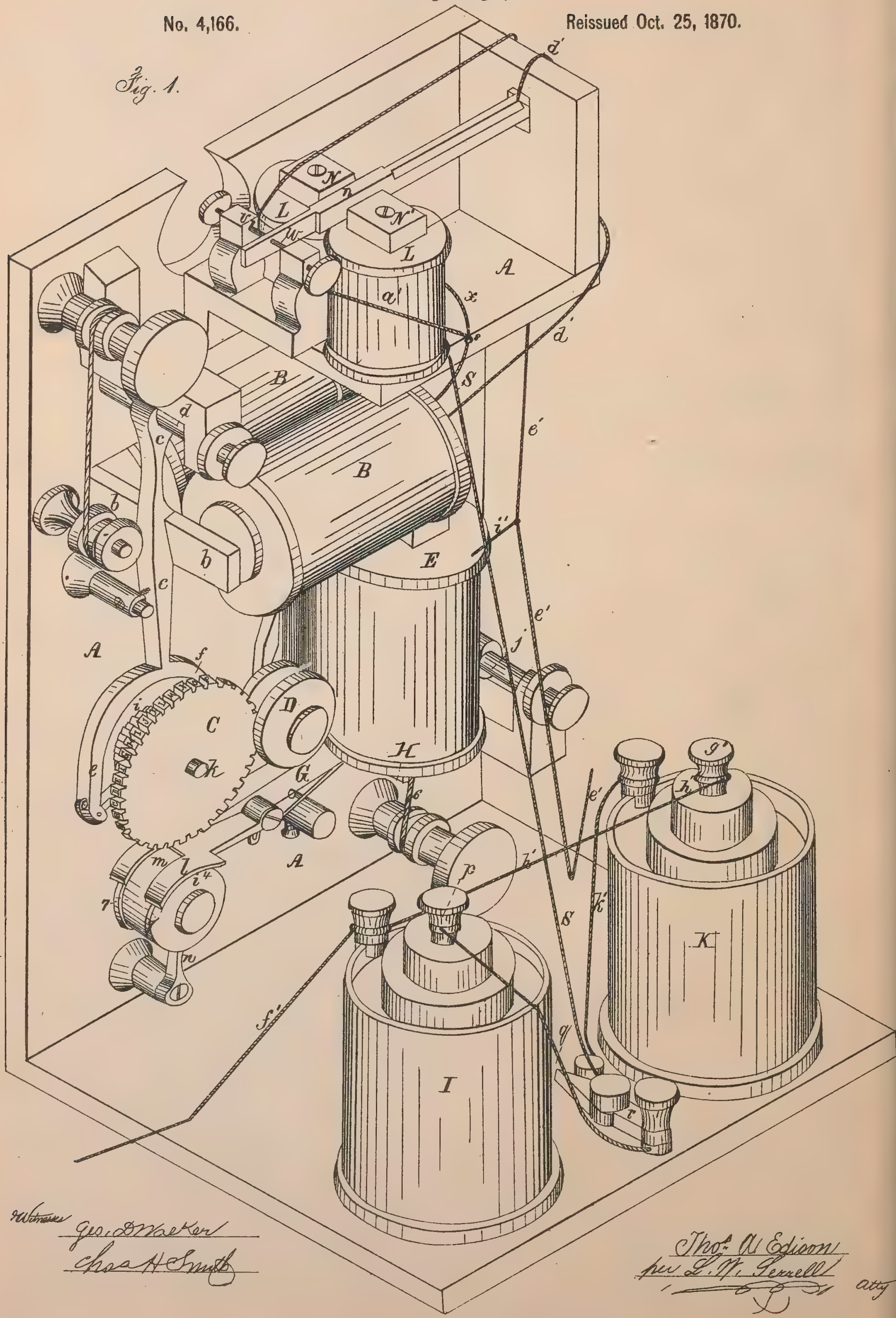
4 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 4,166. Reissued Oct. 25, 1870.

Fig. 1.



Witnesses Geo. D. Walker Chas. H. Smith

Thos. A. Edison per L. W. Serrell atty

N. PETERS, Photo-Lithographer, Washington, D. C.

4 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 4,166.

Reissued Oct. 25, 1870.

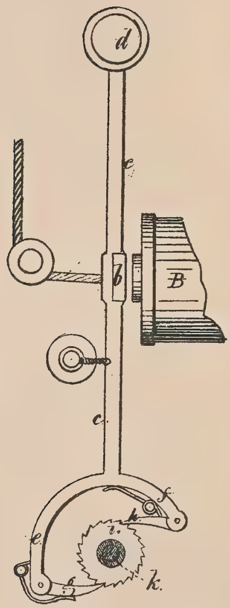
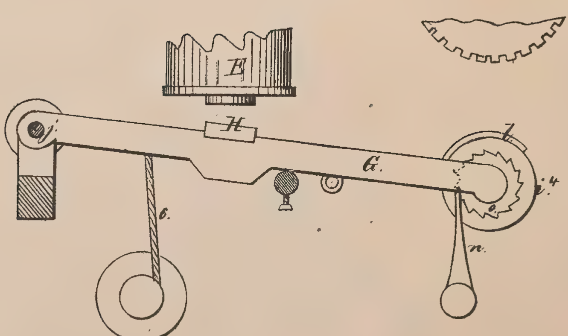


Fig. 2.

Fig. 3.



Witnesses,

Geo. D. Walker

Chas. H. Smith

Thos. A. Edison.

per Lemuel W. Serrell att.

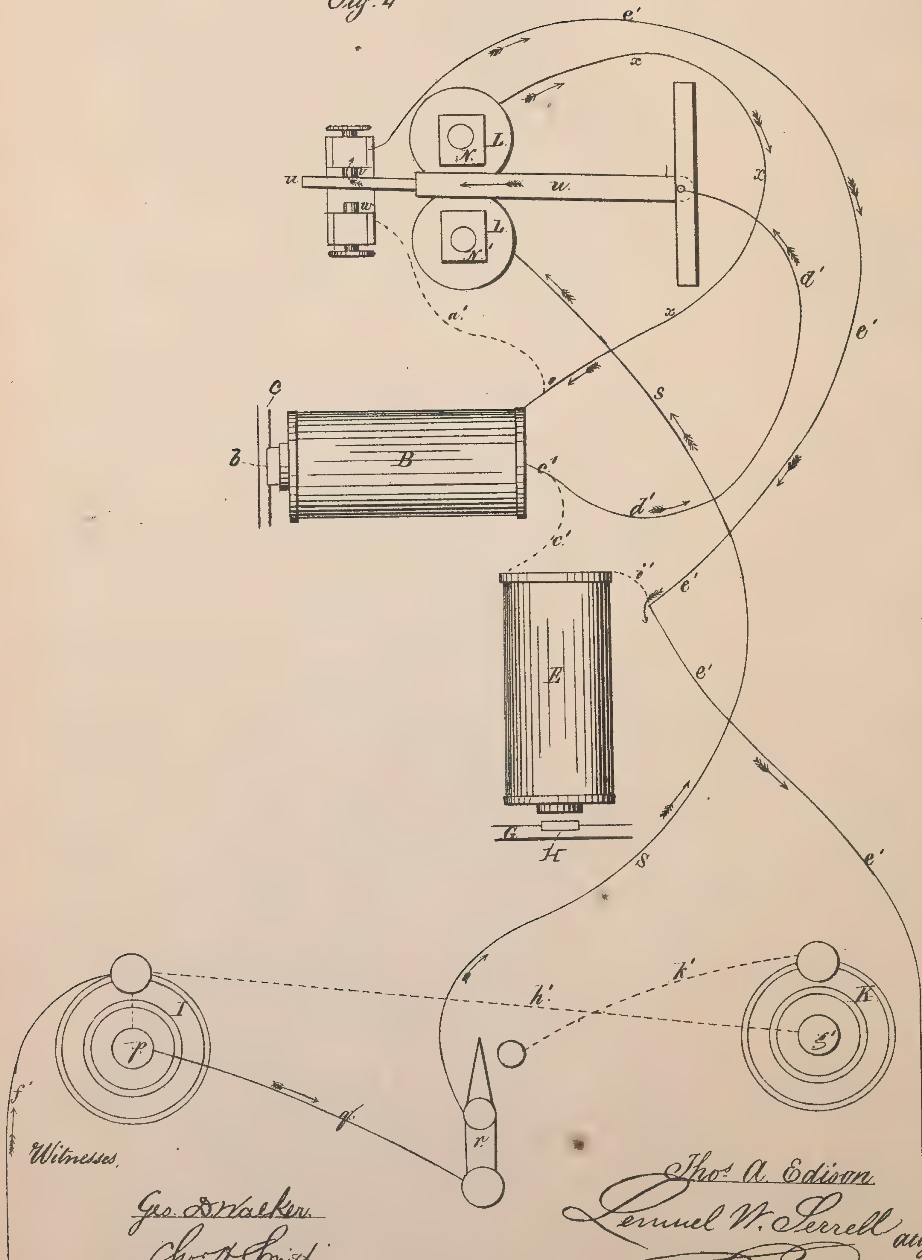
4 Sheets—Sheet 3.

T. A. EDISON.

Printing Telegraph.

No. 4,166. Reissued Oct. 25, 1870.

Fig. 4



Witnesses.

Geo. D. Walker.
Chs. H. Smith.

Thos. A. Edison
Lemuel W. Serrell atty.

T. A. EDISON.

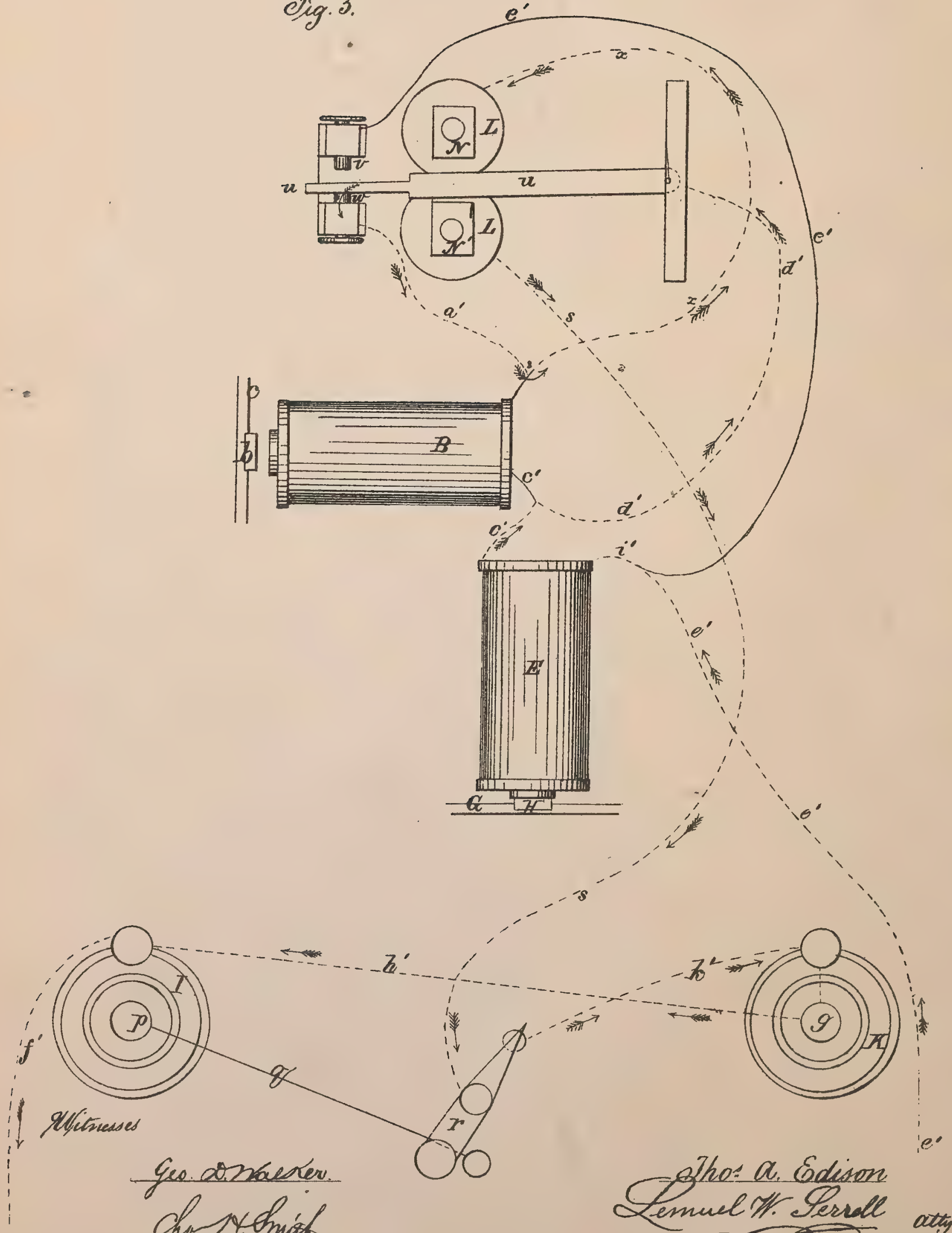
4 Sheets—Sheet 4.

Printing Telegraph.

No. 4,166.

Reissued Oct. 25, 1870.

Fig. 5.



Witnesses

Geo. D. Walker.

Chs. H. Smith

Thos. A. Edison

Lemuel W. Serrell atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 91,527, dated June 22, 1869; Reissue No. **4,166,** dated October 25, 1870.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, now of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

This invention relates to a printing-telegraph in which an electro-magnet is employed for setting the type-wheel by a step-by-step movement and another magnet is used for giving the impression upon the strip of paper, the special feature of my invention consisting in the combination of the foregoing parts with a circuit-changer actuated by the polarity of the current, so that the instrument at the receiving-station is under the control of the operator at the transmitting-station, and when pulsations of one polarity are sent the circuit-changer causes said pulsations to operate to set the type-wheel, the printing-magnet and its branch circuit being cut out, and when a pulsation of the opposite polarity is sent the circuit-changer is moved so that the branch circuit to the printing-magnet is closed and the circuit to the type-wheel magnet is rendered inoperative. By this means one wire may be used for operating the printing-telegraph, and several machines in one main line may be simultaneously operated, and no attendants are required at the receiving-stations. Weights, springs, and clock-work are not required, and each current acts with its full force upon the electro-magnet to which it is directed in the branch circuit, so that local batteries or relay-magnets are rendered unnecessary.

I also make use of a double-acting escapement with a type-wheel printing mechanism and electro-magnet operated by the main circuit, whereby both the breaking and closing stroke of the armature assist in the movement of the type-wheel.

In the drawings, A represents the frame of the apparatus, to which is attached an electro-magnet, B B, of the usual construction.

C is a type-wheel, whose periphery is provided with suitable letters or other characters, which revolves upon a stud or shaft, *k*.

The armature *b* of the electro-magnet B is attached to a lever, *c*, suspended upon an arbor, *d*. The lower end of the lever *c* is bifurcated, as seen in Figures 1 and 2, the two arms *e f* carrying pawls *g h*, which engage at opposite points upon the periphery of the ratchet-wheel *i*, which is fixed upon the same shaft as the type-wheel C and revolves with it. It will be understood by reference to Fig. 2 that each vibration of the lever *c* backward or forward will cause the ratchet-wheel *i* to advance in its revolution the distance of one tooth in the same direction.

The type-wheel C receives its supply of ink from the roller D in any well-known manner.

The electro-magnet E is similar to the electro-magnet B and is attached to the frame A. The armature H, Fig. 3, is attached to the lever G, Figs. 1 and 3, which swings upon its axis at *j*, and is provided at its opposite extremity with a roller, i^4, which occupies a position immediately beneath the type-wheel C.

The strip of paper upon which the communications are to be printed is led from a suitable reel (not shown) over the roller i^4, upon which it is held with a sufficient degree of friction by a spring-arm, *l*, provided with an open slot, *m*, so that when the roller i^4 is raised by the action of the electro-magnet E upon the lever G the strip of paper is brought in contact with whatever letter or character may at that time be opposite upon the type-wheel C, thereby printing the impression of said letter or character upon the paper. When the action of the electro-magnet E ceases, the lever G is drawn back to its original position by a spring, 6. After each impression has been made the strip of paper is moved forward by means of a pawl, *n*, which, when the lever G is drawn back, engages with the teeth of a ratchet-wheel, *o*, Fig. 3, which is secured to the roller i^4, causing the said roller to revolve and draw the paper forward a sufficient distance to produce the required space between the letters. The edges 7 of the roller i^4 are roughened to prevent the paper from slipping during the movement.

The arrangement of the electrical connections and the manner in which either of the electro-magnets B or E may be operated while

the other is caused to remain inactive will now be described, reference being had particularly to Figs. 1, 4, and 5.

I and K are two voltaic batteries, which may be of any suitable construction. The positive pole of the battery I and the negative pole of the battery K are shown as connected to ground or earth wires f' h', and their opposite poles to a key, r, which is so arranged that either the positive pole of K or the negative pole of I may be placed in connection with the line-wire s at pleasure. The apparatus just described is supposed to be situated at the transmitting-station and the line-wire s to extend to the receiving-station, where the printing apparatus is supposed to be placed. The arrangement of the connection at the receiving-station is as follows: L is a small electro-magnet with a circuit-changer or permanently-magnetized bar, u, pivoted in such a position that one of its extremities is free to vibrate as acted upon by the poles N N′ of the electro-magnet L, its movement, however, being limited by the contact-screws v and w. The circuit-changer or bar u is to be made of magnetized steel or of soft iron of a character to be moved by the change in the polarity of the electro-magnet. By a well-known law of magnetic action, when an electric current passes through the helices of the electro-magnet L, the bar u will be attracted by one of its poles and repelled by the other, and when the said current is reversed, or, in other words, changed from positive to negative, or from negative to positive, the bar will be attracted by the opposite pole and repelled by the pole which in the first place attracted it. The manner in which this action is applied to the operation of the apparatus will now be explained.

Referring to Fig. 4, suppose the battery I to be placed in connection with the line-wire s by means of the key r. The current from the negative pole p passes (as indicated by the arrows) by the wire q to the key r, thence by the line-wire s through the electro-magnet L, thence by wire x to the point 8, where a branch, a, goes to the contact-point w; but as the circuit is interrupted at this point the current goes through the electro-magnet B, which actuates the type-wheel. After passing through B two routes are open to the current, one by wire c', electro-magnet E, and wire i', and the other by wire d', bar or "switch" u, contact-point v, and wire e'. As the latter route offers a very small resistance compared with that through E, the current will take this route in preference, as shown by the arrows, and the electro-magnet E will remain inoperative. The circuit, after being completed as above described, may be alternately broken and closed by means of an ordinary transmitter (not shown) for the purpose of operating the armature b, and thereby rotating the type-wheel C, the mechanism connected with which is so arranged that the circuit requires to be closed and broken once in order to move the wheel C a distance equal to that between two successive letters or characters. This insures the circuit being open whenever a letter is brought into position to allow of its impression being taken off upon the strip of paper. When the type-wheel has been rotated (by operating the transmitter) until the desired letter or character has been brought into position opposite the roller i^4, the current is reversed by shifting the key r into the position shown in Fig. 5, which disconnects the battery I and causes the current from the positive pole g' of the battery K to pass through the line-wire s. Upon reaching the receiving-station it will for an instant take the same course as before; but its action upon the electro-magnet L being reversed, the bar or circuit-changer u will be attracted to its opposite pole, so as to come in contact with the point w instead of the point v, as in Fig. 5. The action of an electro-magnet upon a polarized or permanently-magnetic bar being much quicker than upon an ordinary armature of soft iron, the lever u will be shifted from the point v to the point w before the electro-magnet B has time to act. As soon as the bar or circuit-changer u comes in contact with the point w, the current will pass, as indicated by the dotted lines and arrows, Fig. 5, by the wires h' f' e' i' to the electro-magnet E of the printing-hammer, and thence (instead of passing through the electro-magnet B) by the shortest course through the wires c' d' to the tongue u; thence by the contact-pin w and wires a' x to the electro-magnet L, and by the wire s, key r, and wire k' to the zinc pole of the battery K, completing the circuit and causing the armature H to be attracted to the magnet E, raising the lever G and bringing the paper into contact with the letter on the type-wheel, as required. The key r is then moved back into position seen in Figs. 1 and 4, which again reverses the current and causes it to take the course first described through the electro-magnet B of the type-wheel, but not through the electro-magnet E, the armature of which ceases to be attracted, when the lever G, with the roll i, is drawn down by the spring 6 and the paper fed forward to receive the next impression, as required, when the operation continues as before.

It will thus be seen that by the employment of a circuit-changer as above described either one of the electro-magnets B or E may be brought into action and the other cut out of the circuit at pleasure by the reversal of the current, which enables me to greatly simplify the construction of printing-telegraphs and reduce their cost.

The above-described invention is designed particularly for transmitting intelligence from a central station to a number of receiving-stations included in the circuit, in which case no batteries or operators will be required at the receiving-stations; but if messages are to be sent from each station as well as received, then each instrument will require to be provided with a transmitting-instrument, a bat-

tery, and an ordinary switch connected with a ground-wire.

I claim as my invention—

1. A circuit-changer, in combination with an electro-magnet and the type-wheel and an electro-magnet and the printing mechanism, substantially as set forth, whereby the current is directed through either magnet according to the polarity of the current, substantially as set forth.

2. A polarized bar, permanent magnet or circuit-changer, and an electro-magnet to move the same, in combination with an electro-magnet placed in the same circuit and brought into or thrown out of that circuit according to the polarity of the current and the consequent position of the said permanent magnet, substantially as set forth.

3. The combination of a polarized bar or circuit-changer with two electro-magnets operated by a main circuit, substantially as specified, whereby either of the two electro-magnets may be brought into action at pleasure by the use of a positive or a negative current, the other electro-magnet being at the same time inoperative, substantially as set forth.

4. Two or more printing-telegraph instruments placed in one main circuit and operated simultaneously by pulsations of electricity, the type-wheel being set by pulsations of one polarity and the printing being effected by pulsations of the opposite polarity, substantially as set forth.

Dated this 6th day of September, A. D. 1870.

THOMAS A. EDISON.

Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

Thomas A. Edison.

Impt. in Electro Motor Governors.

111112

PATENTED JAN 24 1871

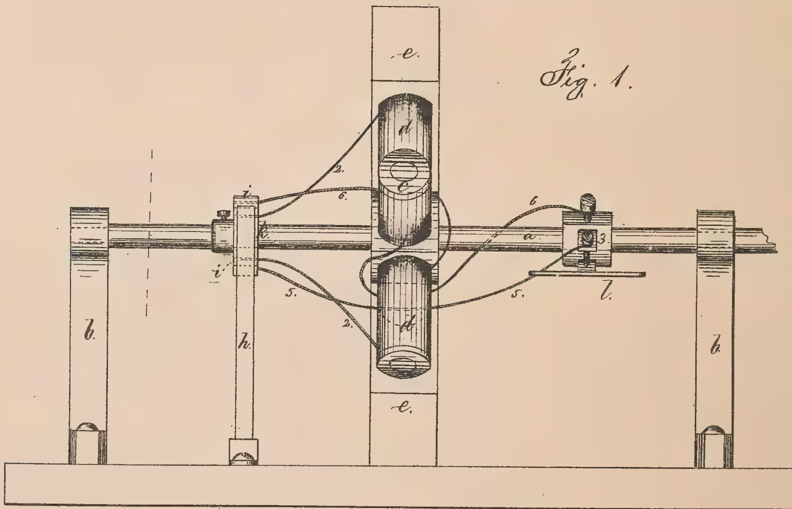


Fig. 1.

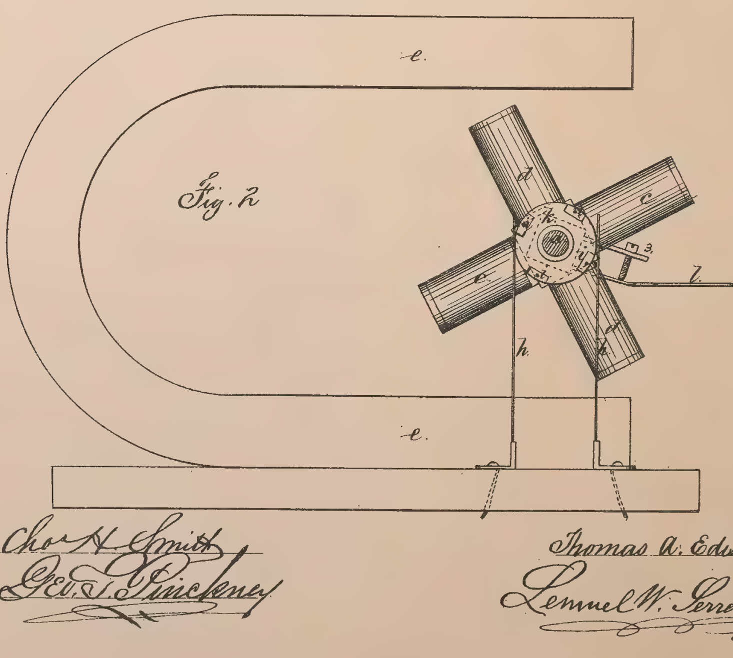


Fig. 2

Witnesses,

Chas H Smith

Geo. T. Pinckney

Thomas A. Edison.

Lemuel W. Serrell Atty

United States Patent Office.

THOMAS A. EDISON OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF, ELISHA W. ANDREWS, GEORGE B. FIELD, AND MARSHALL LEFFERTS, OF NEW YORK, N. Y.

Letters Patent No. 111,112, dated January 24, 1871.

IMPROVEMENT IN GOVERNORS FOR ELECTRO-MOTORS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an improvement in Electro-Motor Governors, and the following is declared to be a correct description thereof.

Electro-motors have heretofore been made by revolving armatures and stationary electro-magnets, and also by revolving electro-magnets and stationary armatures.

My invention is designed for regulating the speed of a revolving electro-magnetic motor by breaking the circuit through one or more of the magnets in case the speed increases beyond the set limit, so as to lessen the power of rotation.

This is effected by a spring or yielding rotary fly acting against the air, but keeping the circuit through it closed, except when the speed of rotation is such that the resistance of the atmosphere causes the arm of the fly to move and break the electrical circuit, so that one or more of the revolving magnets are not charged until the speed lessens sufficiently to allow the fan to close the circuit.

In the drawing—

Figure 1 is an elevation endwise of the revolving shaft that carries the electro-magnets; and

Figure 2 is a side view of the said shaft and parts connected therewith.

The shaft *a* is mounted to revolve in suitable bearings, *b b*, and carries a series of electro-magnets, *c c d d*. I have shown two pairs of such magnets, but the number may be increased.

The stationary permanent magnet *e* is shown, within which the magnets *c c d d* revolve, and said permanent magnet *e*, by the attraction and repulsion of the respective poles of the electro-magnets, produces the rotation of the shaft *a* and magnets *c c d d*, as heretofore well known.

I here remark that stationary armatures might take the place of the magnet *e*, and that the circuits of the magnets *c c d d* are opened and closed by the revolution of the shaft *a*.

The insulated blocks *i i*, in the hub *k*, are connected by wires with the coils in the respective magnets *c c d d*, and the springs *h h*, that impinge upon the periphery of the hub *k*, are connected with a proper battery, either directly or by wires passing through other machinery, or to a distant station.

The blocks *i* are connected in pairs, two on opposite sides, having wires 2 2 leading to the electro-magnets *d d*, the helices of which magnets *d d* are connected.

The other pair of blocks *i i* are connected, the wire 5 passing to the insulated adjusting-screw 3, and yielding-fan *l*, thence by the wire 6 to the magnets *c c*, and through them to the other or opposite block *i*, upon the hub *k*.

It will now be understood that the screw 3 can be adjusted so that when the revolving shaft *a* reaches its maximum speed, the circuit through the wires 5 and 6, screw 3, and fan *l*, will be broken, and the power of the motor be lessened by the magnets *c c* ceasing to act, and so soon as the speed of the motor is lessened, the yielding fly again closes the circuit.

By means of the alternate closing and breaking of the circuit according to the speed, a nearly uniform velocity of the motor is insured; hence two or more instruments can be propelled at almost the same speed, even at distant stations, the regulation of the speed being by the screw 3.

I claim as my invention—

A yielding fly rotating against the atmospheric resistance, and so arranged as to break or close an electrical circuit, in combination with a revolving electro-magnetic motor, substantially as and for the purposes set forth.

Signed by me this 29th day of June, A. D. 1870.

THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

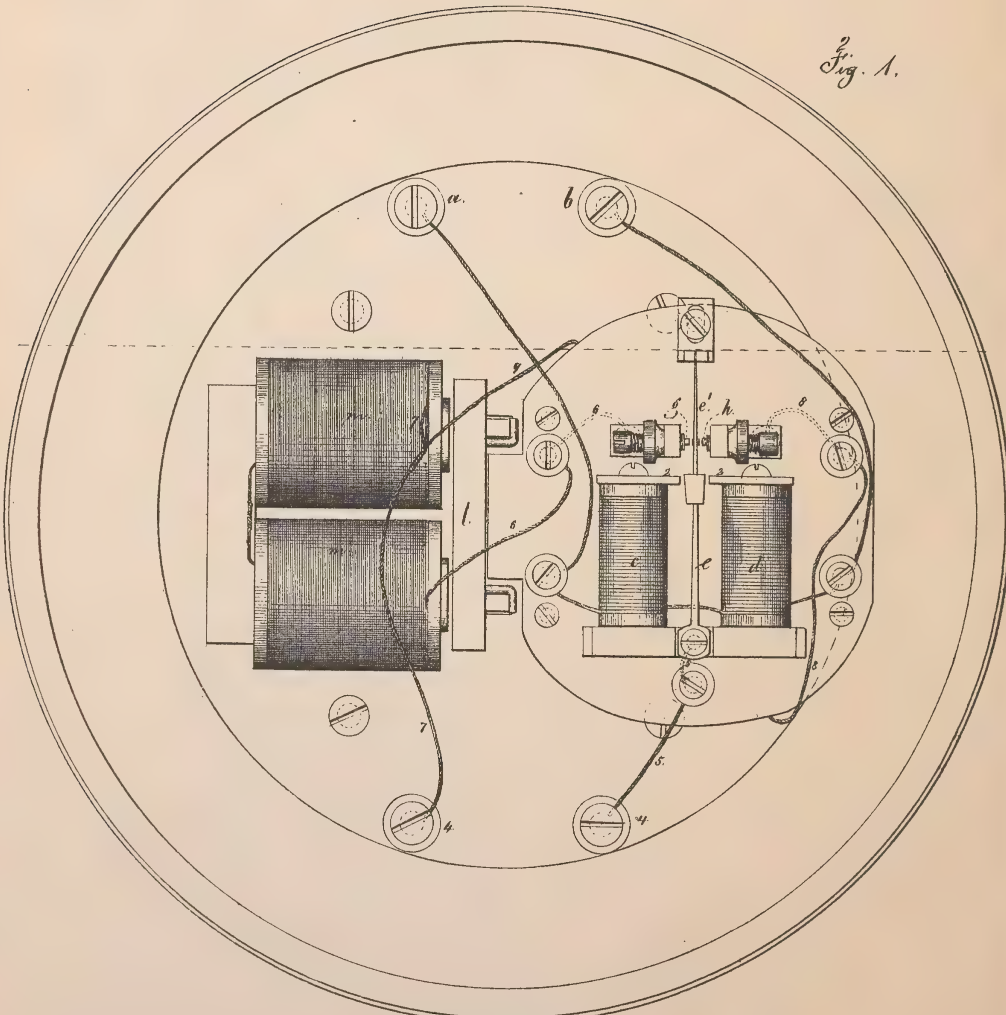
2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph Apparatus.

No. 113,033. Patented March 28, 1871.

Fig. 1.

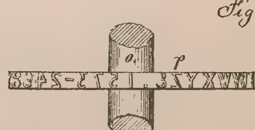


Witnesses.

Chas. H. Smith

Geo. D. Walker.

Fig. 4.



Thomas A. Edison

Lemuel W. Serrell atty

N. PETERS, Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph Apparatus.

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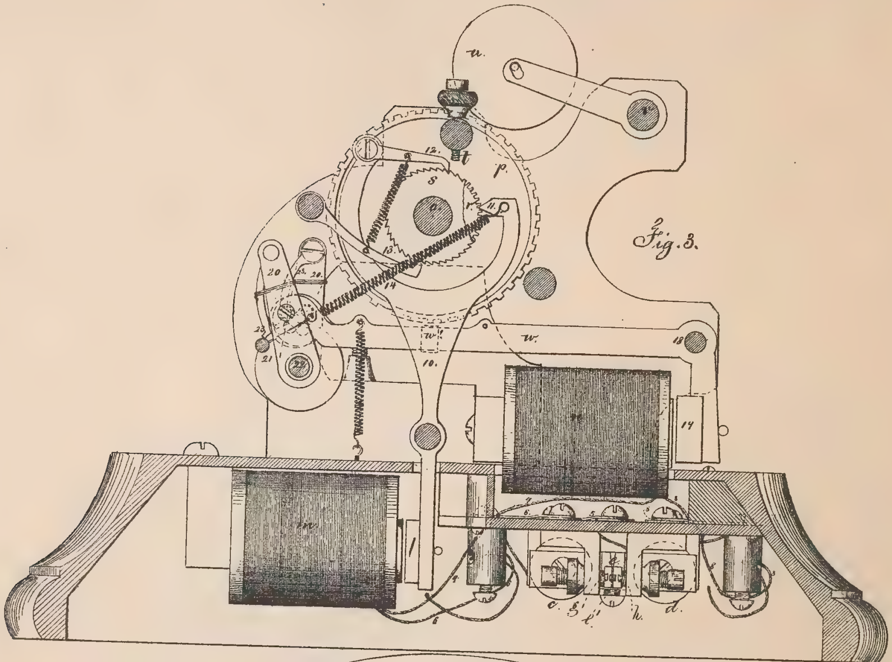


Fig. 3.

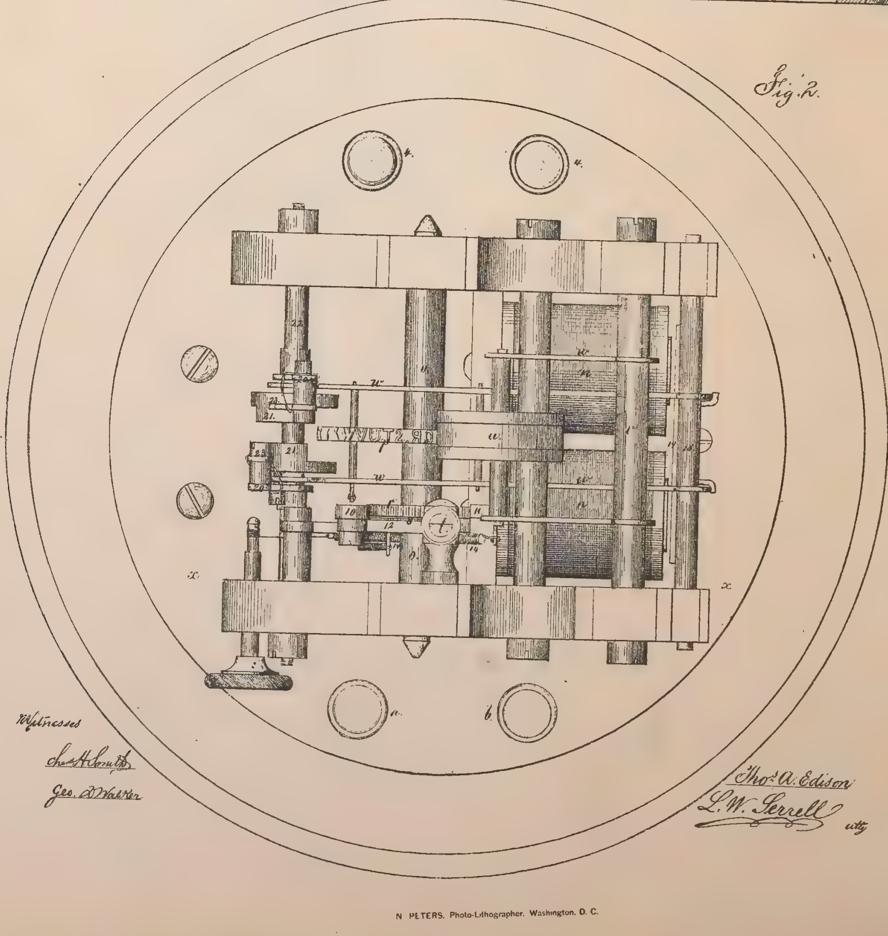


Fig. 2.

Witnesses

Chas. H. Smith

Geo. D. Walker

Thos. A. Edison

L. W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **113,033**, dated March 28, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Telegraph Apparatus, and the following is declared to be a correct description of the same.

The object of this invention is to operate a local circuit and one of two electro-magnets therein from a distant station over one wire by means of pulsations of one polarity operating one electro-magnet in the said local circuit, and pulsations of the opposite polarity operating the other electro-magnet in the said local circuit.

Several stations on one line, each having its own local circuit, can be operated in unison, and I apply to the said magnets means for actuating a type-wheel and a printing-lever at the proper times by reversing the polarity of the current, and I arrange the type-wheel characters in such a manner that the printing of fractions in the quotations of gold, stocks, or market prices is greatly facilitated.

My present invention relates especially to a polarized bar or switch that in a normal condition is maintained in a central position between two circuit-closers by the action of a spring or its equivalent, and adjacent to this polarized bar or switch are the coils and cores of an electro-magnet—one on each side thereof—so that when pulsations of one polarity are sent through the helices the polarized bar or switch is attracted to one side and makes and breaks each pulsation the circuit of a local battery, and thereby actuates one electro-magnet, and when the pulsations in the first-named electro-magnet are of a different polarity the polarized bar or switch works on the other side to make and break the local circuit through a second magnet arranged in that local circuit.

In the drawings, Figure 1 is an inverted plan of my telegraph-instrument. Fig. 2 is a plan of the same. Fig. 3 is a section at the line *x x*, and Fig. 4 is an edge view of the type-wheel separately.

The line-wires are connected with the binding-screws *a b*, and from these the wires pass to the helices *c d* of the soft-iron cores, forming an electro-magnet. Between these helices is the polarized bar or switch *e*, that is made so that it can swing between the poles of the electro-magnet. At one end this bar or switch is connected by a screw, (or it might be by a spring-tongue,) and the other end in its normal condition is midway between the poles 2 2 of the electro-magnet *c d*, and also between the circuit-closers *g h*, and it is held in that position by the thin spring-tongue *e'* or an equivalent yielding centering device. The local-circuit wires come from the battery to the binding-screws 4 4. The wire 5 connects the switch *e* to one of these screws 4. The circuit-closer *g*, wire 6, electro-magnet *m*, and wire 7 connect with the other battery-screw 4, so that when pulsations of one polarity pass through the electro-magnet *c d* the tongue *e* closes the local circuit through *g* and incites the electro-magnet *m;* but when pulsations of the opposite polarity are sent the magnet *m* is not incited, but the electro-magnet *n* is rendered operative by the local circuit, being connected through the screw 4, wire 5, switch *e*, circuit-closer *h*, wire 8, magnet *n*, wires 9 and 7, and binding-screw 4.

Each positive pulsation of electricity in the main line gives a pulsation in one of the magnets in the local circuit, and these pulsations can be repeated to whatever extent desired, because the switch *e* returns to a central or normal position each pulsation, and when the polarity of the main current is changed so as to be negative then the other magnet in the local circuit will be similarly incited, each pulsation in the main circuit. By these means the local circuit at a distant station or the local circuits at more than one distant station are made to operate different magnets, according to the polarity of the current sent, and hence one magnet or set of magnets in the distant local circuit or circuits will be incited to perform one operation, and afterward the other magnet or magnets to perform a different operation. I have shown these magnets *m* and *n* in connection with the printing-telegraph mechanism.

The armature *l* of the magnet *m* has a forked lever, 10, upon one arm of which is a wedge-shaped tooth, 11, and upon the other arm is the pawl 12. Upon the shaft *o* of the type-wheel *p* are two ratchet-wheels, *r* and *s*. The pawl 12, acting upon the teeth of *s*, gives mo-

tion to the type-wheel p and its end runs under the adjustable stop t and blocks the parts, so that the momentum will not cause the type-wheel to turn too far. The swinging pawl 13 takes the teeth of s, preventing any back movement, and as the armature l recedes by the action of the spring 14 the tooth 11 takes into the teeth of the wheel r, and by the inclined wedge-acting end completes the movement of the type-wheel necessary for bringing the next character into place for printing and holds said type-wheel firmly in place. The pawl 12 draws back to take another tooth of s as the tooth 11 comes up against r. The type-wheel is inked by the roller u, that is mounted upon arms and the shaft v. The printing-lever w swings upon the shaft 18, and is actuated by the armature 19 of the magnet n, and said lever w carries the printing-pad w'. The paper is fed along by clamps. The lever 20 and segment 21 move together upon the cross-bar 22, and the lever 20 carries a clamping-pawl, 23, the end of which is contiguous to the segment 21. These parts are duplicated on the other side of the strip of paper and motion is given to one clamp to seize and carry forward the paper as the other clamp draws back, this movement being effected by slots in the ends of the printing-lever inclined in opposite directions and acting upon pins that project from the respective levers 20.

The type-wheel is made with letters and figures and a hyphen or fractional sign, so that the name of the article can be printed and the price in figures and fractions and in quotations of market-values it is usual to reckon in eighths, quarters, or halves. I therefore arrange the figures that will be employed as numerators—such as 1, 5, 7, 3—in the first portion of the line of figures, and then place a hyphen and the other figures thereafter, so that the numerators can first be impressed, then the hyphen or fractional sign, then the denominators. Thereby a saving in time is effected, because the fraction entire can be printed in less than a rotation of the type-wheel—thus: 1-8, 1-4, 3-8, 1-2, 5-8, 3-4, 7-8.

I am aware that in H. and E. Highton's English Patent, No. 12,039, a horseshoe-magnet is pivoted to swing between two electro-magnets to make and break local circuits; but this device is not adapted to a rapid movement and acts in a different manner to my polarized bar or switch. In my apparatus the spring acts instantly to bring the switch to a central position and break the local circuit simultaneously with the break in the main circuit.

I am also aware that a bar has been polarized by the main currents, to act as a switch and dirct the local current to one of two magnets; but said bar was moved only by a change in the polarity of the current.

I claim as my invention—

1. A polarized bar or switch and connections acting as a relay to electro-magnets placed in a local circuit, in combination with an electro-magnet in the main line acting upon such polarized bar or switch to complete the local circuit through one of the two electro-magnets, according to the polarity of the current sent, substantially as set forth.

2. A local circuit, two electro-magnets, a type-wheel, and impression mechanism, in combination with the polarized bar or switch and electro-magnet, substantially as and for the purposes set forth.

3. A series of polarized relays worked in one main circuit and controlling local circuits that operate either type-wheel magnets or printing-magnets, substantially as set forth.

4. A polarized relay having its tongue or switch centered between the poles of an electro-magnet and between the circuit-closers when in a normal condition, substantially as set forth.

5. A type-wheel having letters, figures, and fractional signs arranged in groups for numerators and for denominators on opposite sides of a fractional sign, substantially as set forth, to print letters, figures, and fractions, as specified.

6. A type-wheel with figures arranged on each side of a hyphen or fractional sign, as and for the purposes set forth.

7. The type-wheel motor composed of a vibrating arm and pawls, 12 and 13, combined with a wedge-acting tooth in the manner and for the purposes set forth.

Signed by me this 17th day of November, A. D. 1870.

THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 113,034. Patented March 28, 1871.

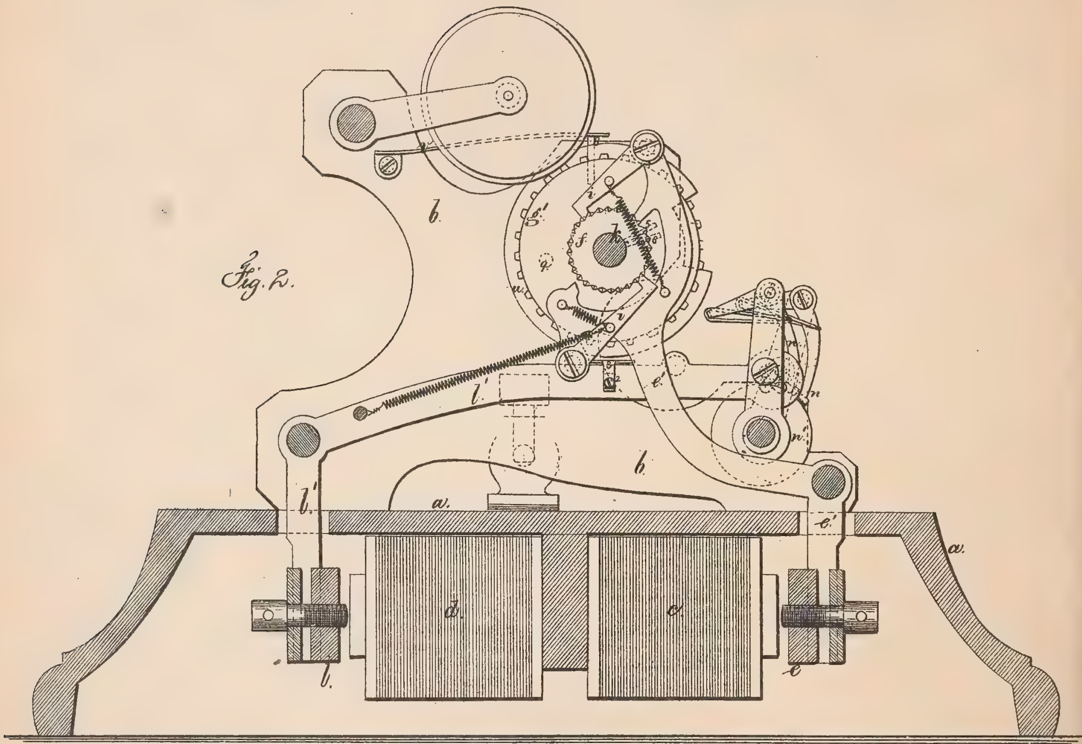


Fig. 2.

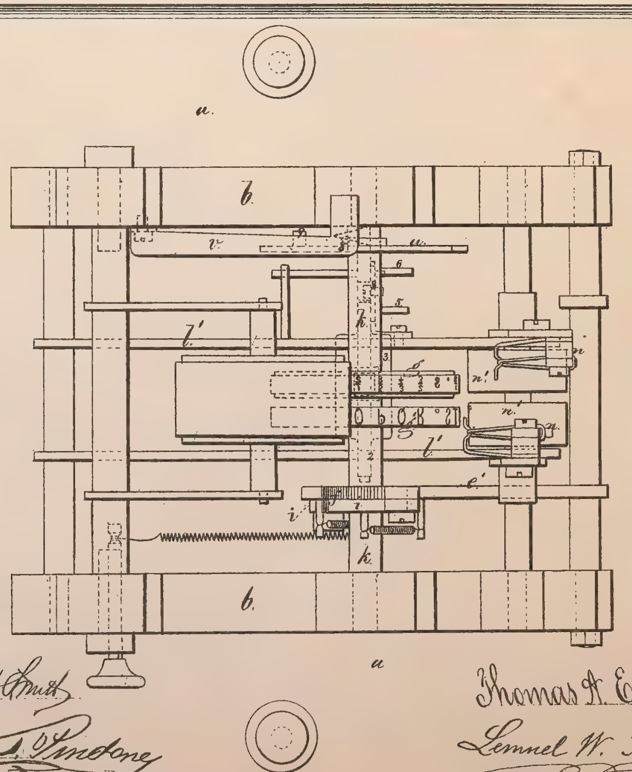


Fig. 1.

Witnesses

Chas H Smith

Geo. T. Pinckney

Thomas A. Edison

Lemuel W. Serrell Atty.

2 Sheets—Sheet 2.

T. A. EDISON.

Printing Telegraph.

No. 113,034. Patented March 28, 1871.

Fig. 4.

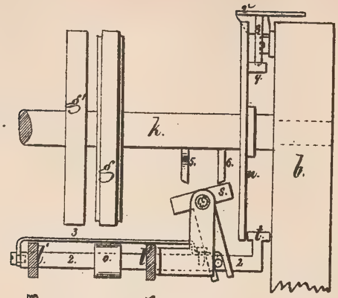


Fig. 3.

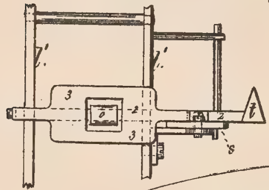
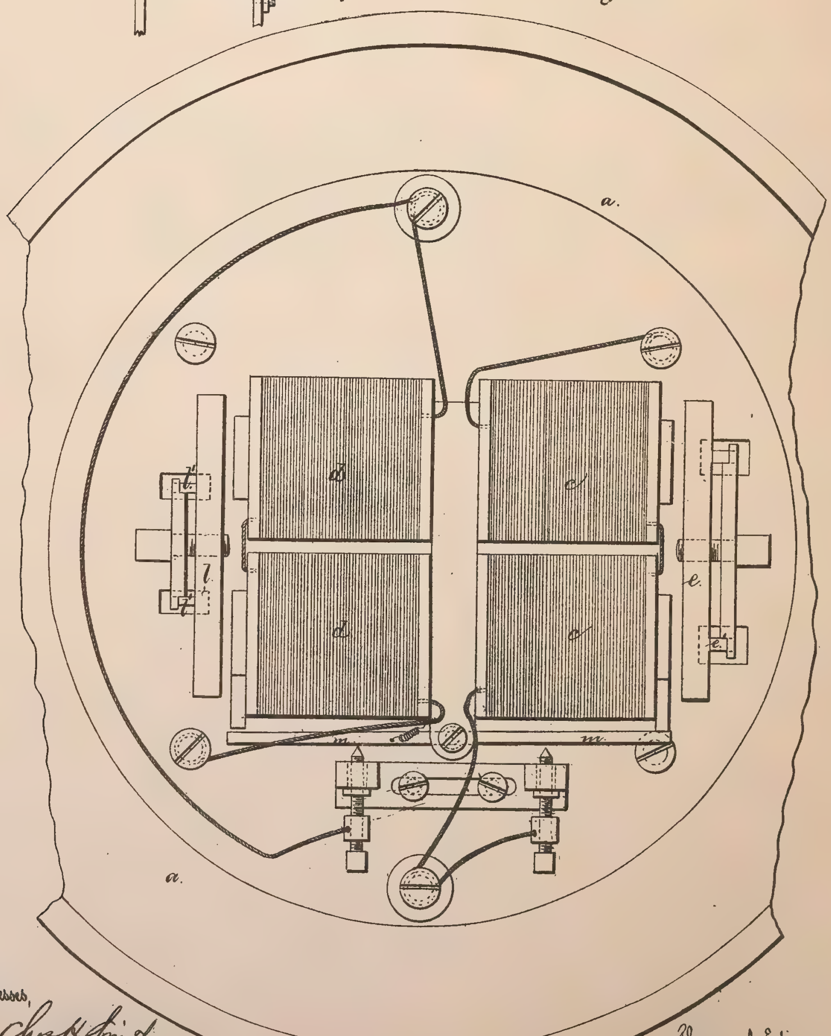


Fig. 5



Witnesses,

Chas H. Smith

Geo. T. Pinckney

Thomas A. Edison.

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. 113,034, *dated March* 28, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description thereof.

This invention is made for printing from one of two type-wheels at pleasure, by changing the printing-pad from the line of one wheel to that of the other.

By this means a printing-telegraph or a number of instruments in one circuit can be worked with one wire, and the impressions be taken from either the letter-wheel or the figure-wheel, and the impression given by reversing the circuit.

If, therefore, the telegraph is required for printing letters, the same can be done without the loss of time incident to passing over figures, as in the type-wheels that contain both letters and figures; and when figures or fractions are to be printed, that can be done regardless of the contiguous wheel containing letters.

The pressure-pad is shifted in the impression-lever by a movement derived from the motion of the printing-lever at the time the blank spaces of the type-wheels are contiguous to the pad.

In the drawing, Figure 1 is a plan of the machine. Fig. 2 is a sectional elevation. Fig. 3 is a detached plan of the printing-pad. Fig. 4 is a detached elevation of the type-wheels and pad-shifting device. Fig. 5 is an inverted plan of the machine.

The bed *a* is provided with frames *b*, that carry the mechanism, and within the bed *a* are the electro-magnets *c* and *d*.

The magnet *c* acts upon the amature *e* to give motion to the lever *e'*, pawls *i*, ratchet-wheels *f*, shaft *k*, and type-wheels *g*, *g'*, and *h*; and the magnet *d* acts upon the armature *l* of the printing-lever *l'*.

The polarized switch *m* directs the current through either the magnet *c* or the magnet *d*, according to the polarity of that current, and these magnets and connections, being substantially similar to devices heretofore secured to me, (see Patent No. 4,166, reissue,) need not be herein described.

The printing-lever *l'*, paper-feeding clamps *n*, and rollers *n'* are similar to the lever and its connections shown in my Patent No. 4,166, except in the devices next described.

The impression-pad *o* is mounted upon a slide, 2, that passes across the lever *l'* and beneath the type-wheels, and a small shield, 3, is attached to this slide, and has an opening above the pad *o*, so as to interpose between the paper and the type-wheel, except directly over the pad *o*.

Near one end of the slide 2 is an arm upon the printing-lever, carrying the fulcrum of the shifting-dog *s*, that is made of a T shape, the lower end being slotted and taking a pin that projects from the slide 2; and upon the type-wheel shaft *k* are two figures, 5 and 6, that are so placed relatively to the blank spaces of the type-wheel that the figure 5 comes over one end of the dog *s* as one blank space of the type-wheel comes over the pad; hence, if the impression-lever is moved at this time, the pad will be shifted by the dog *s* being pressed up against the finger 5, and if the type-wheel is moved another notch the finger 5 passes beyond the dog *s*, and the figure 6 comes over the other arm of said dog, and in this position the pad will be shifted the other way by the movement of the printing-lever.

It is now to be understood that when the printing-pad is beneath the number-wheel *g* the impression will be made from the same, and there will be no impression from the other or figure-wheel, and vice versa; hence, either wheel can be made use of for an indefinite period, the same as any ordinary printing-telegraph; and when it is desired to bring the other type-wheel into action it is only necessary to turn the type-wheel around until the finger 5 or 6 is brought over the elevated arm of the dog *s*, and then reverse the electrical current to move the impression-lever, which gives a motion to change the impression-pad laterally and bring it under the other type-wheel *g'* or *g*, and then the type-wheels can be moved around to bring the proper letter of the letter-wheel or figure of the figure-wheel into position for impression, so that, although two types are in position, an impression only is taken from the one beneath which is the pad *o*.

In order to prevent any risk of the pad *o*

shifting by the vibration of the parts, I provide an inclined holder, *t*, on the end of the slide 2, and a disk, *u*, upon the shaft *k*.

This disk is notched at one side to allow the pad to be shifted either way, and when the type-wheel is revolved the disk *u* passes either one side or the other of the holder *t*, and, if the pad *o* and its slide has not been fully moved either one way or the other, this disk completes that movement by acting against the incline of the holder *t*.

The transmitting instrument may be a dial and revolving arm with two blank spaces, one denoting the point at which to stop and move the printing-lever to change from letters to figures, and the other to change from figures to letters.

A spring, *v*, with a pin, 8, may be employed to take against a pin, 9, on the disk *u*, to afford an indication, when depressed, of the place at which to stop in changing the instrument. Said pin also answers for bringing the instrument into unison where there are several in the same line. This unison stop-lever will be operated by the attendant at each station when it becomes necessary to set his instrument, by preventing the movement of the type-wheel until the wheel at the transmitting-station is brought to the same zero-point.

I claim as my invention—

1. A shield, with an opening adjacent to the pressure-pad and moving with the same, in combination with two contiguous type or character wheels and mechanism for actuating the same in a printing-telegraph instrument, substantially as set forth.

2. A movable pressure-pad, mounted upon the printing-lever, and two contiguous type-wheels on one shaft, in combination with two electro-magnets and armature, and a circuit-changer, substantially as set forth, whereby the type-wheels are set by one electro-magnet, and the pressure-pad is either changed in position or the printing effected by reversing the polarity of the electrical current, substantially as set forth.

3. The movable pad, mounted upon a transverse slide in the impression-lever, in combination with the shifting-dog *s*, and fingers 5 and 6 upon the type-wheel shaft, substantially as set forth.

4. The notched disk *u* and inclined holder *t*, in combination with the shifting-pad *o*, substantially as and for the purposes set forth.

5. The unison-stop lever *v*, in combination with the shifting-pad and two contiguous type-wheels, substantially as set forth.

Signed by me this 10th day of January, A. D. 1871.

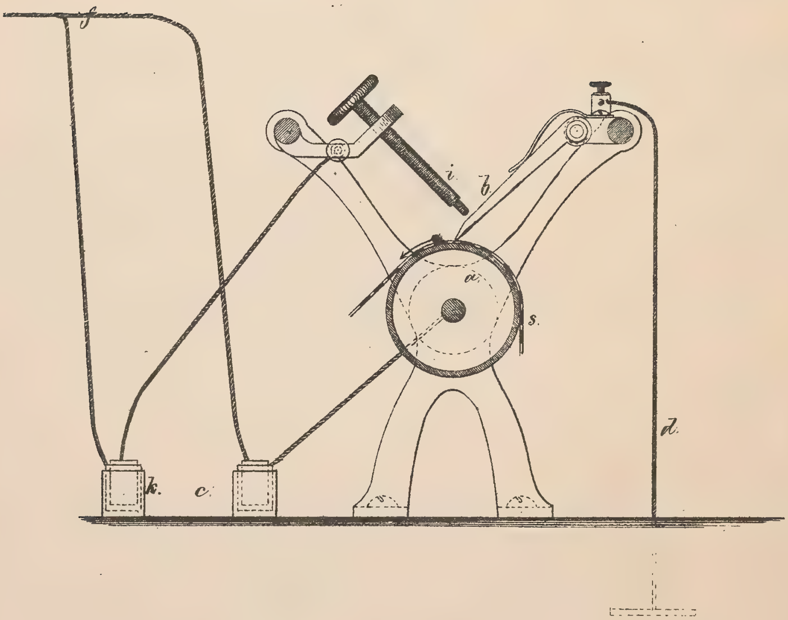
THOMAS A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Telegraphic Transmitting Instruments.

No. 114,656. Patented May 9, 1871.



Witnesses,

Chas. H. Smith

Geo. D. Walker

Thomas A. Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPHIC TRANSMITTING-INSTRUMENTS.

Specification forming part of Letters Patent No. **114,656**, dated May 9, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improved Telegraphic Transmitting-Instrument; and the following is declared to be a correct description of the said invention.

In telegraphing, a perforated strip of paper has been employed to make and break the electrical circuit in trasmitting the message. In transmitting-instruments adapted to said paper there is a small disk or wire brush that closes the metallic circuit through the perforations, and the circuit is broken by the paper when the unperforated portion intervenes between the roller or plate and the disk or wire brush.

The transmission of pulsations of electricity being very rapid in this system of telegraphing, there is a difficulty that sometimes arises from the wire not clearing itself, and the pulsations are attenuated and do not distinctly reach the distant station.

My invention consists in arranging the connections and portions of the instrument in such a manner that a reverse current shall be thrown upon the wire of the circuit by a motion derived from the thickness of the paper when the same is drawn in between the plate or roller and the brush or disk.

In the drawing, the device in question is represented by a side view.

Let *a* represent a plate, roller, or metallic surface, over which the strip of perforated paper *s* is drawn, and *b* represent a wire brush, stilus, or roller, these parts being of any known character, for sending pulsations of electricity to a distant receiving-instrument. The battery is represented at *c*, and the ground-wire at *d* and the line-wire at *f*. The current will therefore be sent, when the circuit is closed, through the perforation of the paper; and when the unperforated portion of the paper is beneath the brush or stilus *b* the end is lifted sufficiently to touch, or nearly so, the point *i*, that is adjustable and mounted in any convenient manner. By the said movement the battery *k* is brought into action by closing the circuit between *i* and *b*, and a reverse current is thrown upon the telegraph-line, thereby preventing the attenuation of the previous pulsation, clearing the wire, and causing the mark at the receiving-station to be clear and distinct.

I claim as my invention—

A circuit-closer operated by the movement of the perforated paper in a telegraph transmitting-instrument to throw a reverse circuit on the line, substantially as set forth.

Signed by me this 22d day of June, A. D. 1870.

THOMAS A. EDISON.

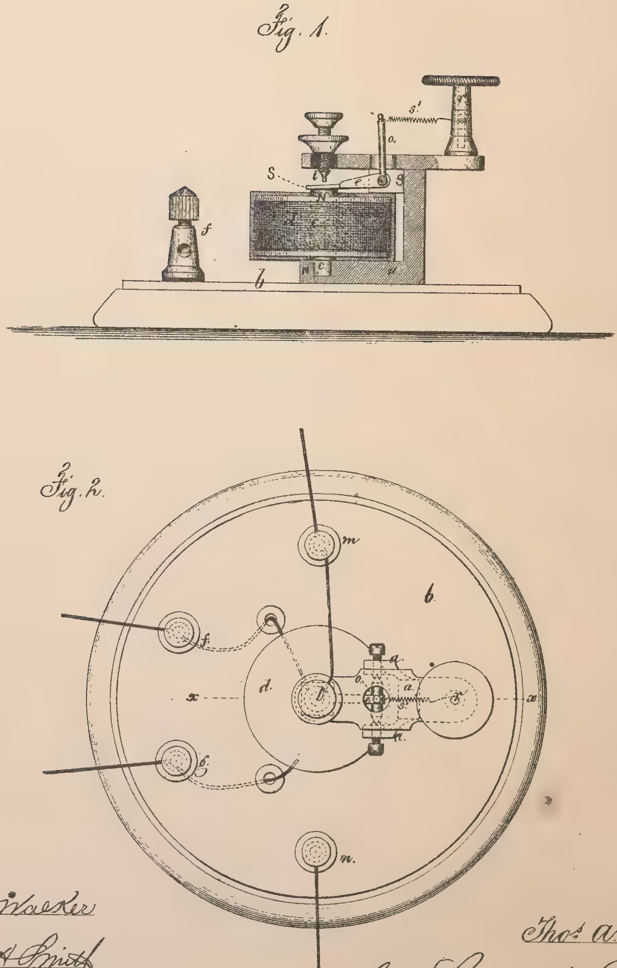
Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Relay Magnet for Telegraph Instruments.

No. 114,657.

Patented May 9, 1871.



Witnesses,

Geo. D. Walker

Chs. H. Smith

Thos. A. Edison

per Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND MARSHALL LEFFERTS, OF NEW YORK CITY.

IMPROVEMENT IN RELAY-MAGNETS FOR TELEGRAPH-INSTRUMENTS.

Specification forming part of Letters Patent No. **114,657**, dated May 9, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electro-Magnets; and the following is declared to be a correct description thereof.

The object of this invention is to produce an electro-magnet that can be operated with great rapidity and accuracy, and capable of being used as a relay or repeater for a chemical telegraph operated by punched paper and a stilus or brush circuit-closer, or for a time-repeater in astronomical or other observatories, or for a relay or repeater to a Morse telegraph-instrument, or wherever great rapidity or accuracy of movement is required.

I make use of a soft-iron core to a short single-spool electro-magnet, and this is mounted upon one end of a permanent magnet, and the other end of said permanent magnet is near the core of the electro-magnet, and has a small hinged tongue, so that the tongue is attracted to the core by the polarity due to the induced magnetism of that core and tongue, and the coils of the helix are so wound as to make the core, by a pulsation, an electro-magnet of an opposite polarity to what it was by the induced magnetism.

The attraction from the induced magnetism is almost counterbalanced by a spring; hence the slightest current of electricity that will neutralize the induced magnetism will produce a motion of the tongue and close or break a secondary local relay, or other electrical circuit; and the core being very short and the connections direct, the magnet frees itself rapidly and can be operated by the most minute pulsation.

In the drawing, Figure 1 is a vertical section of the instrument at the line *x x* of Fig. 2, which is a plan of said instrument.

The permanent magnet *a* is sustained upon the bed *b*, and is magnetized so that one end of it is a north polarity and the other south. They are marked N. S.

Upon the pole N of the permanent magnet *a* is a soft-iron core, *c*, surrounded by a helix, *d*, and this helix is wound in such a manner and so connected to the insulated binding-screws *f g* that the pulsation of electricity will make the soft-iron core *c* of a different polarity from what it is by the induced current, so that if the core *c* is upon the north pole of *a*, then the induced current will make the core *c* a magnet of northern polarity, and the pulsation of electricity in the helix will neutralize that induced magnetism, making or tending to make the soft-iron core an electro-magnet of southern polarity.

At the end *s* of the magnet *a* a small iron tongue, *e*, is hinged, so as to vibrate with the moving end over the core *c*, and to this tongue a spring is applied and made adjustable in any suitable manner.

I have shown the arm *o*, spring *s'*, and adjusting-rod *r*, and the power of the spring is adjusted so as not to be sufficient to raise the tongue *e*, the attraction between *e* and *c* from induced magnetism being just sufficient to keep the parts *e* and *c* in contact.

Above the tongue *e* is an adjustable circuit-closer, *l*, that is insulated and connected to the binding-screw *m;* and the tongue *e* is connected, through the magnet *a* and base *b*, with the other binding-screw *m*.

A primary circuit is connected with the binders *f* and *g*, and, where a local or secondary circuit or relay is operated by this device, the wires thereof are connected to *m* and *n*, and the said local or secondary circuit is closed by the rising of the tongue *e*, when the pulsation through *f*, *g*, and *d* sufficiently neutralizes the induced magnetism in *c* and *e* to allow the spring to separate them.

In consequence of using a short single helix, with short connections and a short tongue, having but a small movement, there is nothing to interfere with the movement being very rapid; and, the circuit-closer of the local or secondary circuit being immediately over the electro-magnet, there is no loss of time or motion in making the connections of the secondary circuit.

The electro-magnet operates to repel the tongue *e* at the time the tongue is in contact; hence, there being no intervening space, the magnetic action is more instantaneous than it would be if a space intervened, as with an ordinary armature.

In consequence of the features aforesaid, all

acting to promote rapidity of action, this electro-magnet is capable of repeating with a secondary or relay circuit the pulsations given by punched paper drawn through a transmitting-machine at ordinary rate, and to properly proportion the dots, dashes, and spaces; and this speed and accuracy of movement are available for other purposes in electrical appliances.

I do not claim a magnet with a single helix and core; neither do I claim a polarized magnet in which a permanent magnet and tongue are employed. I have discovered that, in order to obtain a rapid electro-magnet that is adapted to a relay or repeater in automatic telegraphs, the vibrating tongue must, in a normal position, remain in contact with the core by induced magnetism and be repelled by the electro-magnetism, or else the space intervening between the core and tongue will interfere with the rapidity of action; and the electro-magnet must not be more than an inch in length to free itself of the electrical pulsation with sufficient rapidity; and, the tongue swinging upon an axis at right angles to the core of the electro-magnet, the said tongue will vibrate in the line of the magnetic action, and more rapidly than the polarized magnets, in which the tongue swings on an axis parallel to the core of the electro-magnet.

I claim as my invention—

1. A permanent magnet, an electro-magnet, and a vibrating tongue, arranged substantially as set forth, so that the tongue will be repelled from its contact with the core of the electro-magnet by the electric pulsation, substantially as specified.

2. An electro-magnet of less than an inch in length, with a permanent magnet and swinging tongue to make and break the circuit in an automatic telegraph, substantially as and for the purposes set forth.

3. The electro-magnet, permanent magnet, and a tongue that swings toward and from the end of the core of the electro-magnet upon an axis at right angles to such core, as and for the purposes set forth.

Dated September 6, 1870.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Electro-Magnets for Telegraph-Instruments.

No. 114,658. Patented May 9, 1871.

Fig. 2.

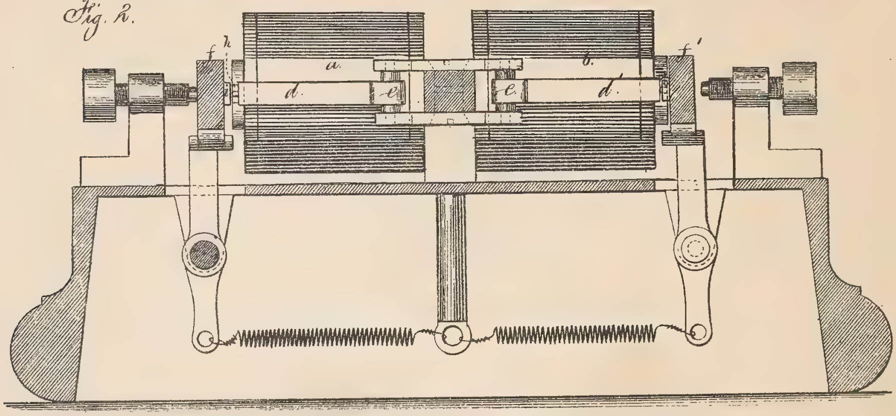
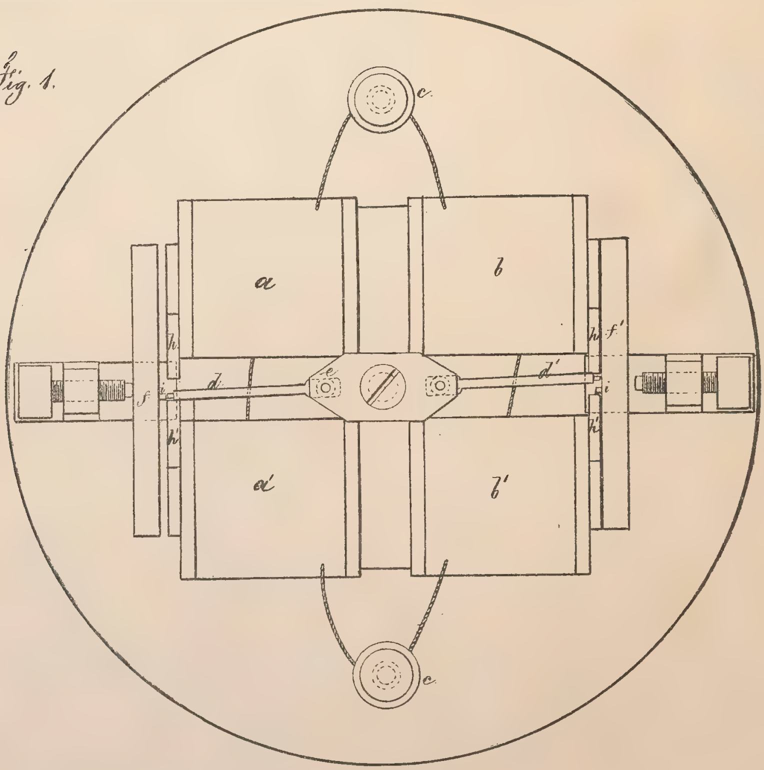


Fig. 1.



Witnesses.

Chas H. Smith

Geo. D. Walker.

Thomas A. Edison

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND MARSHALL LEFFERTS, OF NEW YORK CITY.

Letters Patent No. 114,658, dated May 9, 1871.

IMPROVEMENT IN ELECTRO-MAGNETS FOR TELEGRAPH INSTRUMENTS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Electro-Magnets for Telegraphs, &c.; and the following is hereby declared to be a correct description thereof.

This improvement relates to a means for rendering an electro-magnet inoperative when a current of one polarity is used, and operative when a current of the opposite polarity is employed so that two different operations may be performed in a telegraph or other machine with only one wire.

The invention consists in a blocking-finger or stop, that prevents the movement of the armature, said stop being operated according to the polarity of the electro-magnet.

In the drawing—

Figure 1 is a plan of a double magnet, and

Figure 2 is a vertical section.

The magnets *a a'* and *b b'* are of any ordinary or desired construction, and are connected with the line-wires of a telegraph or the electrical circuit in any usual manner, *c c* representing the binding-screws, and the connections are substantially as shown, so that the pulsations of electricity pass through the magnet or magnets.

Between the poles of the magnet a finger, *d*, is fitted to swing on the fulcrum *e*, and the end is continuous to the armature *f*, and there is a block or equivalent device, as at *i*, so that when the finger *d* is swung toward the pole *a* the armature *f* will be free to vibrate; but when said finger *d* is swung toward the pole *a'* the armature will be locked, so that it cannot vibrate.

The locking action may be of the character shown, so that the armature may be kept away from the magnets, or in the form of a hook, to keep the armature toward the magnet.

The electro-magnets are provided with the lateral arms *h h'*, and these become polarized, according to the positive or negative polarity of the current; hence the finger *d* is attracted or repelled, and swung to one side to block the armature, or to the other side to release the same.

This construction may be availed of to render operative or inoperative one electro-magnet in any machinery. I, however, have represented a double magnet constructed and connected so that one armature, *f'*, can be locked and rendered inoperative by the finger *d'*, while the armature *f* is operative, in consequence of the finger *d* being swung out of action, and *vice versa*, the operations being reversed by changing the polarity of the currents, the pulsations always going through the magnets; and in these particulars this present invention is to be distinguished from those heretofore made by me, in which the polarity of the current operates devices that divert the current from one magnetic coil into another.

I claim as my invention—

1. A finger or stop operated by electro-magnetism, and arranged so as to block or release the armature according to the polarity of the electrical current passing through the magnet, substantially as specified.

2. The double electro-magnet, armatures, and stops, arranged substantially as specified, so that a current of one polarity shall allow one armature to vibrate and block the other, and the reverse, as set forth.

Signed by me this 22d day of June, A. D. 1870.

THOMAS A. EDISON.

Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

(507)

3 Sheets—Sheet 1.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.

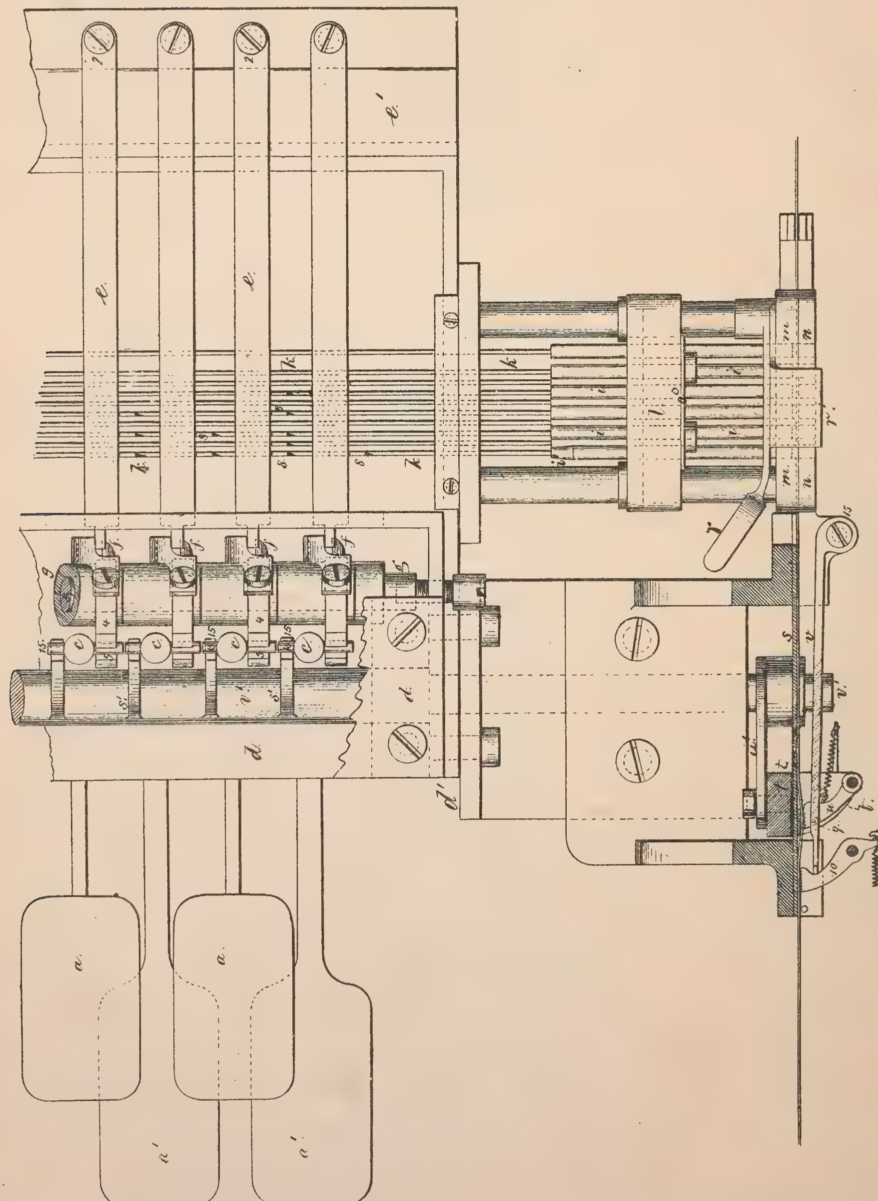


Fig. 1.

Witnesses.

Chas H Smith

Geo. D Walker.

Thos. A. Edison,

L. W. Serrell

3 Sheets--Sheet 2.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.

Fig. 2.

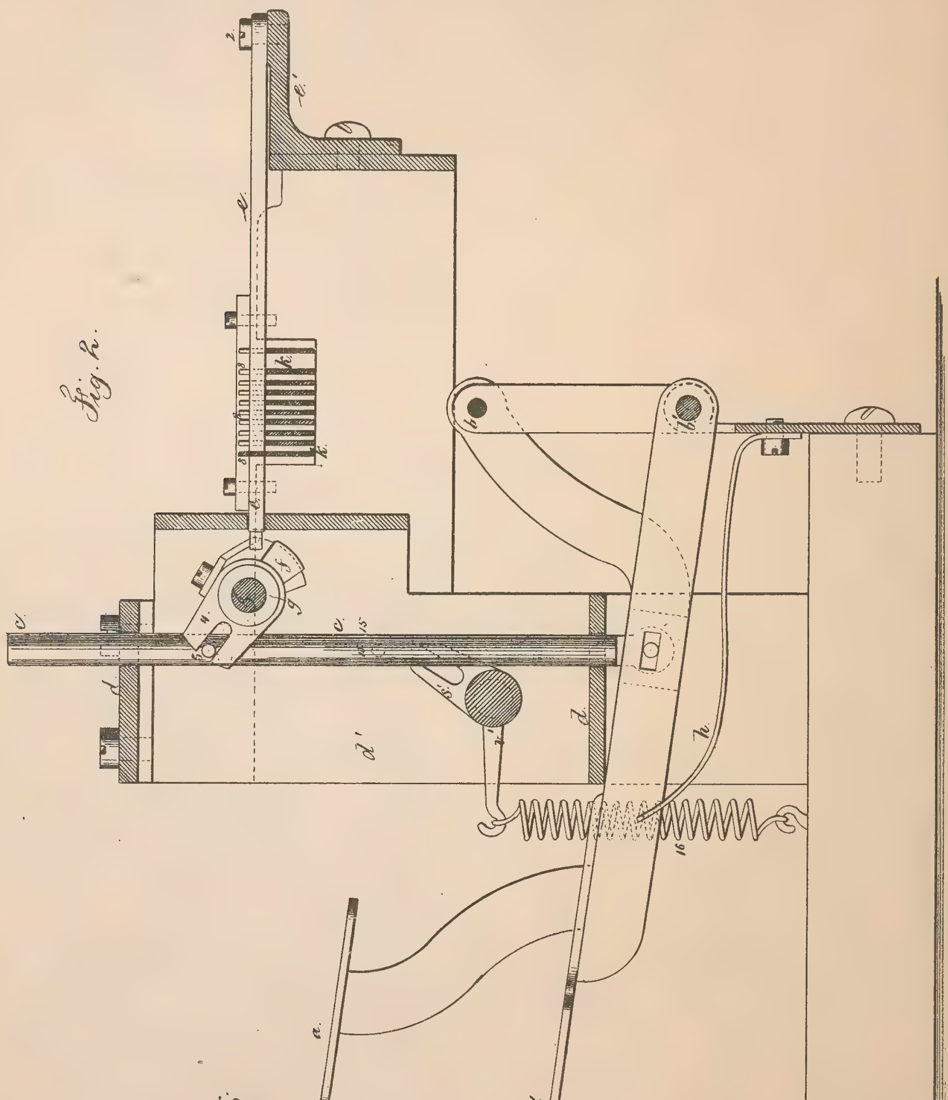


Fig. 4.

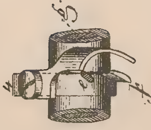


Fig. 6.

Witnesses,

Chs. H. Smith

Geo. D. Walker

Thos. A. Edison,

L. W. Serrell atty.

(50.)

3 Sheets--Sheet 3.

THOMAS A. EDISON.

Machinery for Perforating Paper for Telegraphic Purposes.

No. 121,601. Patented Dec. 5, 1871.

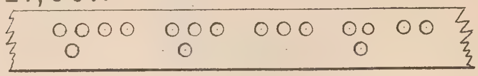


Fig. 3.

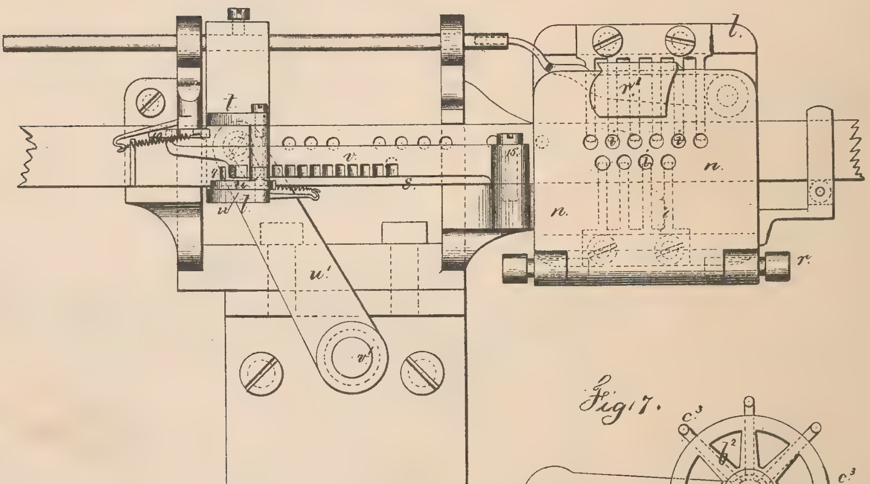


Fig. 7.

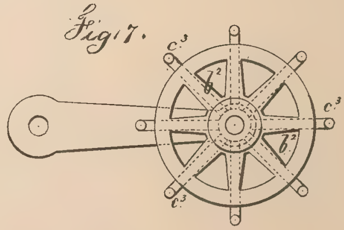
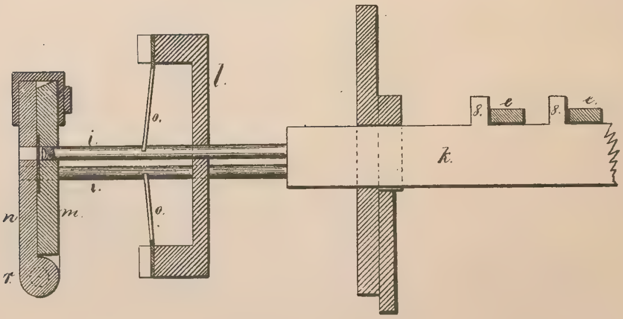


Fig. 5.



Witnesses.

Chas D Smith

Geo D Walker

Thos. A. Edison,

L. W. Serrell

atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN MACHINERY FOR PERFORATING PAPER FOR TELEGRAPHIC PURPOSES.

Specification forming part of Letters Patent No. **121,601**, dated December 5, 1871.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Perforating Machinery for Telegraphic Purposes; and the following is declared to be a correct description thereof.

This machinery is for perforating strips of paper employed in transmitting telegraphic messages, the perforations in the paper allowing the circuit to be closed, as heretofore well known. A range of finger-keys is provided, and also a range of slide-plates operating upon punches. A presser-lever is connected by a cam with each finger-key, and contiguous thereto are projections upon such of the slide-plates as are to be actuated by the said finger-key; thereby on striking the finger-key the proper punches are actuated to punch the perforations necessary for the letter complete; and on releasing the finger-key the paper is drawn along the proper distance by a peculiar feeding mechanism, and the perforations are made in two lines, so that where three or more perforations are placed triangularly a long pulsation may result from the metallic connection being made through those perforations successively, the contact being made through the second perforation before ceasing through the first, and so on.

In the drawing, Figure 1 is a plan of a portion of the instrument with the paper-feed in section. Fig. 2 is a vertical section at the finger-keys. Fig. 3 is an elevation of the paper-feed and dies. Fig. 4 is a separate view of the cam that actuates the presser-lever. Fig. 5 is a cross-section of the punches and dies, and Fig. 6 is a modification of the device that connects the finger-key and presser.

The finger-keys *a a* are mounted upon a fulcrum-shaft, *b*, and the second range of keys *a′* swing on the shaft b^1, this arrangement facilitating the construction and allowing the keys to be arranged compactly, and at the same time they are convenient for fingering. The vertical bars *c c* slide in supports *d*, and are jointed at their lower ends to the keys *a a′*, or otherwise connected. These supports *d* form part of a frame, with end pieces *d′* that inclose the key-levers and connected parts, and also sustain the shaft *v′* that is employed for actuating the paper-feed, the paper and mechanism that act upon the same being outside the end piece *d′* of said frame. The presser-levers *e e* are connected by screws or pins 2 on the frame or bar *e′* so as to swing horizontally, and are each actuated by a cam, *f*, upon the bar *c*, as in Fig. 6; or by a swinging cam upon a sleeve surrounding the stationary bar *g*, as shown in Figs. 1, 2, and 4; said swinging cams being provided with jaws 4, in which the pins 5 of the bars *c* slide as the latter are depressed by the finger-key. These cams *f* are shaped so as to give a definite movement to the levers *e* and slide-plates *k* sufficient to operate the punches, and then the levers *e* are relieved to allow the springs of the punches to throw them back out of the paper, the presser *e* and punch or punches being operated as the key is depressed, and as the key is relieved the movement of the cam *f* in the other direction insures the drawing back of the presser-lever *e*. Each finger-key is raised by a spring, *h*, and there are to be as many finger-keys and parts operated by each as there are letters or separate characters employed in telegraphing. Beneath these pressers *e* are the slide-plates *k k*, corresponding in number to the punches employed. The punches *i i* are round steel rods sliding in the heads *l m* and acting against the dies *n* to punch the paper that is introduced between *m* and *n*, and the rear ends of these punches should be made smaller, as shown at *i′*, in order that there may be room for the ends of the slide-plates *k* to pass between the adjacent punches and only act upon its own punch. The ranges of springs *o* enter notches in the punches *i* and throw the punches back, and the punches are positioned in two lines, as seen in Fig. 5, the distance between the punches being less than the diameter of the punch, and the punches of the upper range are above the spaces between the lower punches; thereby, if three contiguous punches are simultaneously actuated, the perforations will be equivalent to a dash, and cause a long pulsation from the transmitting instrument and produce a dash at the receiving instrument. Upon the slide-plates *k* are projections 8, contiguous to the pressers *e*, and these projections 8 are to be upon only such of the slide-plates as are required to be moved by the presser to which they are contiguous,

so that only those slides will be moved upon depressing a finger-key that operates the punch or punches that make the perforations for the corresponding character; hence the necessary perforations can be made in the strip of paper for composing the message by dots and dashes, the dashes at the receiving station being of any desired length, according to the number of consecutive perforations in the two lines of perforations made in the paper.

By this arrangement any desired character of alphabet or code of signs can be adopted within the scope of the instrument; and I remark that the number of punches may be increased at pleasure, and also the number of finger-keys.

By boring the holes in *l m n* for the punches all at the same time they will all be properly in line with each other, and the punches *i*, being round parallel wires notched for the ends of the springs, are easily made or replaced. The cutting end of each punch is to be a conical or concave hole, and the sharpening is to be effected by deepening this hole by a proper tool. These punches will cut the paper with less power and more reliably than the flat-ended punches heretofore used.

The parts *m n* are to be hinged together at *r* to allow the die-plate *n* to be swung open in removing any obstruction. The clip *r′* holds the die in place when shut. The paper-carrier *t* is moved back toward the punches *i* each time a finger-key is depressed, and during the time that the paper is being punched and the feed takes place as the key rises. The backward movement is to be the distance required for the character that is simultaneously punched. The mechanism for giving this motion may be of any suitable kind. The device which I employ for this purpose is next described.

A rack-bar, *v*, swinging upon the screw 15, is provided, and in the lower edge are inclined or cam-shaped teeth, and upon the carrier *t* is a pawl, *u*, with an inclined finger, 9; hence as the carrier *t* is moved back the pawl *u* is lifted from the paper by finger 9 turning upon the teeth of the rack-bar *v*, and the carrier and pawl can be moved back any required distance and the paper remain unacted upon, and is held by the spring-pawl 10; but as soon as the carrier *t* commences to move in the other direction the inclined finger 9 slips into the first opening between the inclined teeth of the rack-bar, allowing the end of the pawl *u* to approach the paper and clamp it against a thin carrier-plate on *t* that is in front of the fence *s*, and as the carrier *t* moves along the paper is drawn through between *m* and *n* until the carrier *t* reaches its extreme movement and the finger 9 clears the last tooth on the rack-bar *v*. During this movement the pawl 10 has been entirely raised from the paper by the end of the rack-bar *v* acting thereon while the finger 9 has traveled between said rack-bar and the paper. It will be thus seen that the paper is very firmly held while being moved, and that there is nothing that is moving in contact therewith and tending to injure the paper as the carrier draws back, and that the feeding motion can be to any desired extent. The motion given to the sliding carrier is shown as derived from the rock-shaft *v′* and arm *u′*. Upon the rock-shaft *v′* are forked cams *s′*, contiguous to the slide-bars *c*. The pins 15 on the slide-bars *c* enter the fork as the keys are depressed and give the required motion to the rock-shaft to move the sliding carrier back. The spring 16 acts to move the paper forward as the key rises. By positioning the pin 15 higher up or lower down it will be brought into action later or sooner in the movement of the key, and hence move the carrier *t* to a greater or less distance, and the amount that is required for the character or letter perforated by the depression of that key.

It will be apparent that when a key is struck the appropriate punches will be operated and instantly retracted, and that simultaneously the carrier and paper-feeding mechanism will be thrown back without acting on the paper. The inertia of the parts will carry the slide *t* slightly further back, and the spring *u* brings it forward before the key is relieved sufficiently for the finger 9 to enter between the teeth of the rack-bar and place the parts ready to move the paper as the key is liberated. The movement given to the paper-feed is fourfold: First, it is relieved; second, it draws back clear of the paper; third, it comes upon the paper and clamps it; and fourth, it moves with the paper. The paper is drawn along suddenly as the feed takes place; hence the paper-reel is suddenly moved and the paper thrown off the reel in a bow or loop. I construct my roller so as to prevent this occurrence. The reel b^2, Fig. 7, is made in the usual manner and mounted upon a vertical axis, and around the base of the reel I provide vertical projecting pins c^3, close to but not touching the said base of the reel, so that upon the sudden rotation of the reel the paper coil will be thrown out but cannot pass beyond these pins; thereby the paper will be held in place, and will draw off easily to the perforating-machine, as required.

The transmitting-machine is to be provided with a wire or spring brush to close the circuit through the perforations; and if the end of this brush were diagonal the long pulsation would be produced from the two lines of perforations even if the perforations were nearly in line transversely of the strip of paper.

I claim as my invention—

1. Two ranges of punches for perforating telegraphic paper with holes representing dashes, or dashes and dots, substantially as set forth.

2. A strip of telegraphic paper perforated in two lines, with the perforations arranged so that the long pulsation in transmitting is

obtained from perforations in both lines, substantially as set forth.

3. A series of perforating-punches arranged in two or more lines and supported in heads that are perforated in the line of the opening in the die, substantially as set forth.

4. The die-plate *n*, hinged so as to be opened, in combination with the punches, for the purposes set forth.

5. The springs *o* combined with the punches *i*, and arranged in the manner specified to retract the punches from the die-plate *n*, as set forth.

6. The combination of the sliding punches and sliding plates *k* with the actuating-levers *e*, substantially as set forth.

7. The punches *i* reduced at the end next the slide-plates *k*, for the purposes set forth.

8. The finger-keys *a a'*, in combination with the bars *c*, slide-plates *k*, and levers *e*, substantially as and for the purposes set forth.

9. Mechanism actuated by one movement of a key, substantially as specified, for punching in two rows telegraphic characters consisting of dots and dashes.

10. The finger-keys, cam-rods, levers, and cams arranged between the frames *d'*, in combination with the punching and feeding mechanism operating upon the strip of paper running parallel or so with the finger-keys, as set forth.

11. The paper-feeding mechanism having a reciprocating movement of varying length, according to the character perforated, and acting to grasp the paper and carry the same forward, but not to catch or hold such paper on the return movement, substantially as set forth.

12. The paper-feeding clamp *t* moving upon the slide *s*, in combination with the pawl *u* and mechanism for reciprocating such clamp, substantially as set forth.

13. The rack-bar *v* with inclined teeth, in combination with the pawl *u* and finger 9, substantially as and for the purposes set forth.

14. The holding-pawl 10 operated by the rack-bar *v*, substantially as set forth.

15. The clamp *t*, pawl *u*, and fence *s*, in combination with the rack-bar *v* and pawl 10, substantially as set forth.

16. A reciprocating paper-feed in which the clamping device is lifted off the strip of paper on the backward movement and pressed upon the same on the forward movement, substantially as set forth.

17. The combination of a reciprocating paper-feed with finger-keys that operate the punches, and with mechanism connecting the said finger-keys to the paper-feed in such a manner that the movement given to the paper will be the amount required for the letter or character perforated, substantially as set forth.

18. The slide-rods *c*, pins 15, and cam-fork *s'*, in combination with the rock-shaft *v'* and reciprocating paper-feed, substantially as set forth, for varying the feed according to the position of the pins 15 or their equivalents.

19. In an instrument for punching paper for telegraphic purposes, a series of cams each adapted to operating the mechanism that moves the punches and then releasing such punches during the downward movement of the key, substantially as set forth, so that said punches may be out of the paper before the feed takes place.

20. The paper-reel in combination with the surrounding stationary pins contiguous to the base of the reel, for the purposes set forth.

Signed by me this 16th day of August, A. D. 1871.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
HAROLD SERRELL.

4 Sheets—Sheet 1.

T. A. EDISON.

Telegraph Apparatus.

No. 123,005. Patented Jan'y 23, 1872.

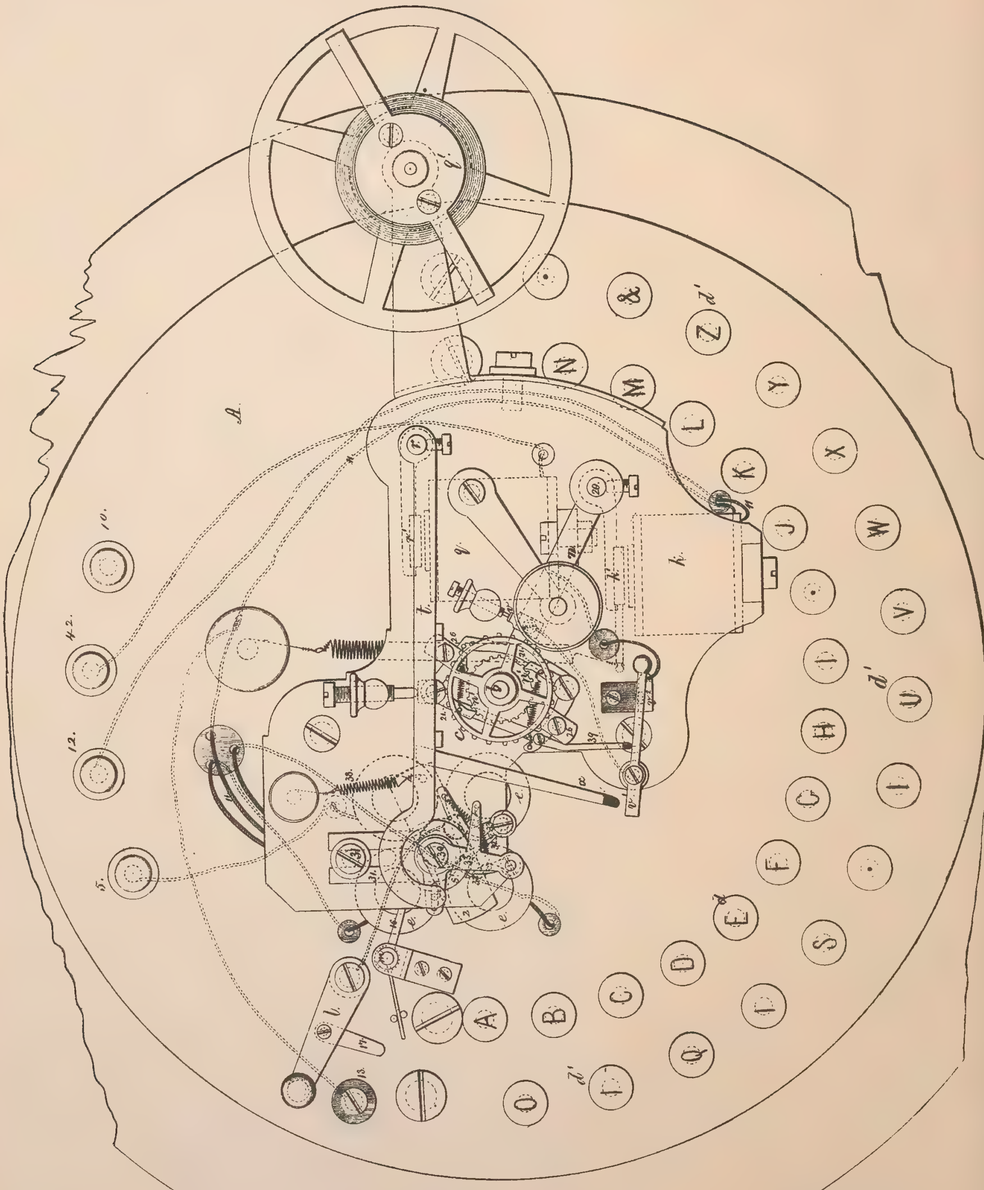


Fig. 1.

Witnesses.
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
Lemuel W. Serrell
Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

4 Sheets—Sheet 2.

T. A. EDISON.

Telegraph Apparatus.

No. 123,005. Patented Jan'y 23, 1872.

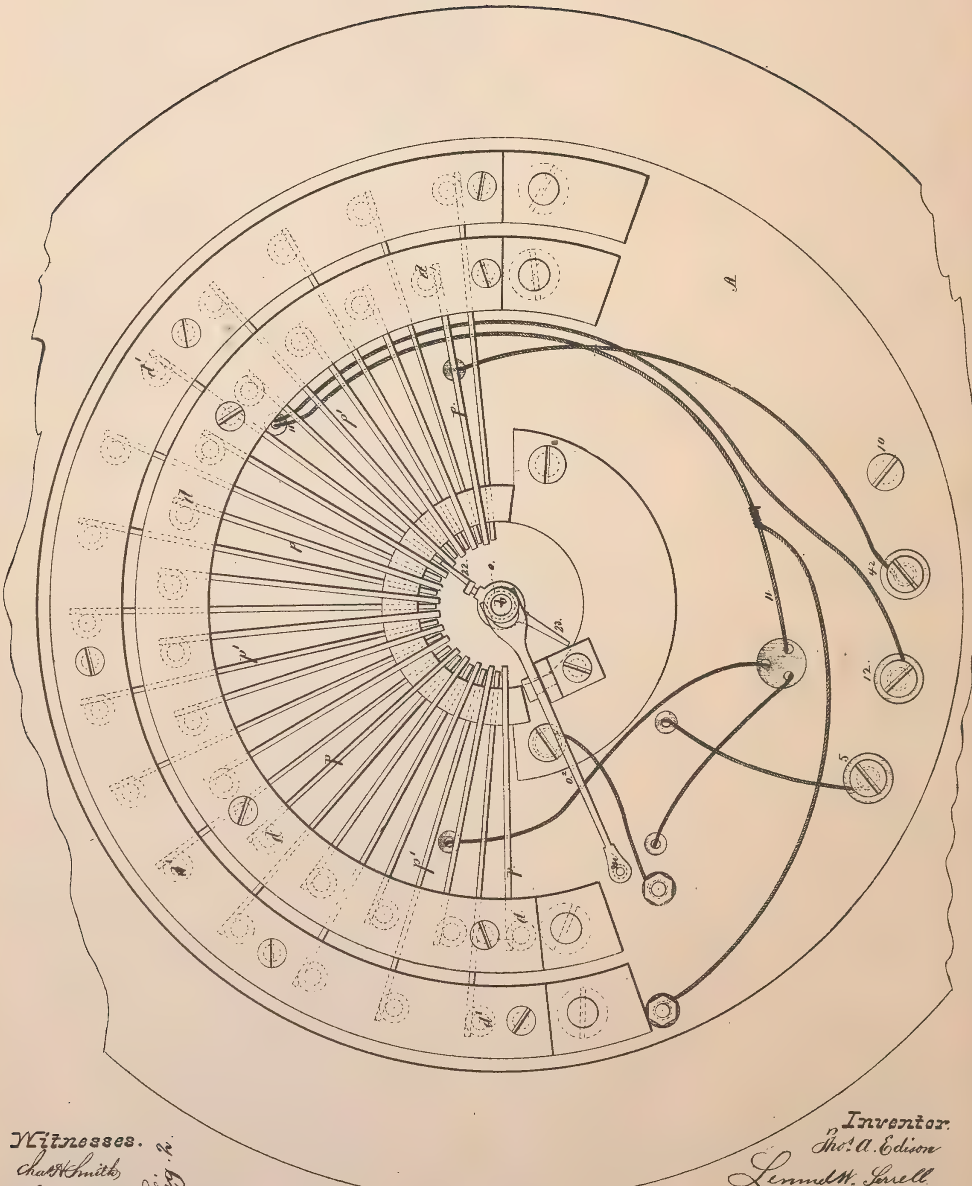


Fig. 2.

Witnesses.
Chas H Smith
Harold Serrell

Inventor.
Thos. A. Edison
Lemuel W. Serrell
atty.

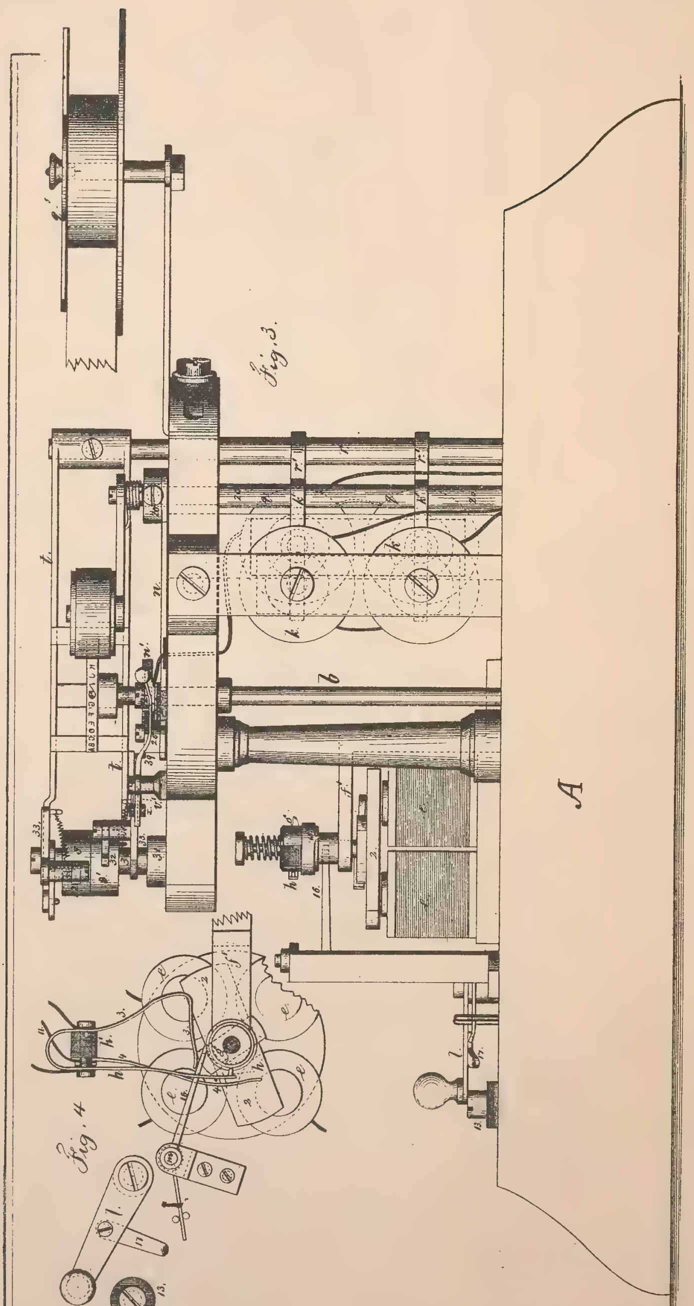
N. PETERS, Photo-Lithographer, Washington, D. C.

4 Sheets—Sheet 3.

T. A. EDISON.

Telegraph Apparatus.

No. 123,005. Patented Jan'y 23, 1872.



Witnesses.

Chas H Smith

Harold Serrell

Inventor.

Thos A. Edison

Lemuel W. Serrell

atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

4 Sheets—Sheet 4.

T. A. EDISON.

Telegraph Apparatus.

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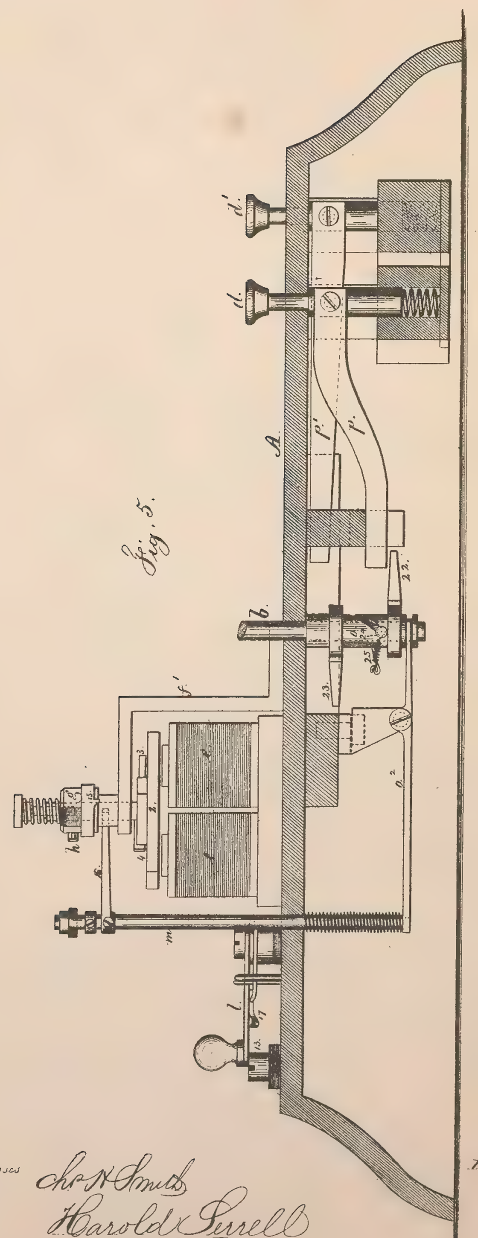


Witnesses Chs H Smith
Harold Serrell

Inventor Thos. A. Edison
Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO "THE GOLD AND STOCK TELEGRAPH COMPANY," OF NEW YORK CITY.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **123,005**, dated January 23, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This instrument I term the "Universal Printing-Telegraph;" and it is intended as a transmitting and as a receiving instrument. When used as a transmitting-instrument, a small magnetic motor, driven by a local battery, makes and breaks the main circuit, and the pulsations operate through a magnet in the transmitting-machine, and also in the receiving machine or machines, to rotate the type-wheel by a step-by-step movement, and the type-wheels, hence, move in harmony. When a finger-key at the transmitting station is depressed, the type-wheel of that machine is stopped, when an arm upon its shaft comes in contact with the said key. This causes the simultaneous stoppage of pulsations over the main line, arresting all the type-wheels at the same point. The impression is now made simply in consequence of the pause that ensues, for the arm that operates the type-wheel pawls closes the circuit of the transmitting-instrument through its own printing-magnet and the other printing-magnets of the line, and the impression is taken. The movement of the impression-lever breaks its own circuit, so that the pad is drawn instantly back by the spring of the impression-lever, and the circuit to the printing-magnet remains broken until the type-wheel is set in motion again, which throws a switch that again closes the circuit to the printing-magnet. The rapidity of movement, however, of the type-wheel lever is such that the printing-magnet does not have time to become sufficiently charged to move the printing-lever before the circuit to said magnet is again broken; hence the printing-magnet is not brought into action except when the pause takes place upon stopping the type-wheel. The circuit through the printing-magnet may either be the main circuit or a local.

In the drawings, Figure 1 is a plan of the instrument. Fig. 2 is an inverted plan. Fig. 3 is a partial side view. Fig. 4 is a plan of the motor and connections, and Fig. 5 is a section showing the loose sleeve and incline that operate the stop for revolving pulsator.

The bed A is provided with a shaft, *b*, upon which is the type-wheel *c*. This shaft *b* is the center of the semicircular ranges of keys *d d′*, the number of which corresponds to the divisions upon the type-wheel, and they should be marked with similar characters arranged properly for the type-wheel. Upon the bed A is a magnetic motor, made of a pair of magnets, *e e*, armature 2, and spring circuit-closers 3 4, connected with the binding-screws 5 and 10, and a local battery, by means of which the armature 2 will be rotated with rapidity. The armature 2 is on a vertical shaft in the frame *f′*, and upon this shaft is the pulsator *g* and a friction-spring that causes the necessary power to be applied to rotate the pulsator, but allows the motor to continue when the pulsator is arrested. This pulsator *g* is made cylindrical, but of alternate conducting and non-conducting materials, and a spring, *h*, rests against the side thereof, and is supported by a column of non-conducting material, *h′*. The metallic connection from the main-line battery is through the binding-screw 10 to the bed of the machine, through the shaft and conducting-surface of the pulsator *g*, spring *h*, and wire 11, to the magnet *k* that moves the type-wheel; thence to the binding-screw 12, main line, and distant instrument. At the distant instrument the switch *l* is moved to the insulated anvil 13, and connects the bed and screw 10 of the machine with one of the wires of the magnet *k*, the other wire of the magnet going to the binding-screw 12, and the pulsator of the receiving-machine is instantaneously stopped, so that all the instruments in the line may be moved by the pulsator at the sending station only. Upon the pulsator *g* there are catches, 15, and an arm, 16, upon a vertical sliding shaft, *m*, is raised by the finger 17 of the switch *l* so as to be in the path of one of the catches 15, to arrest the further revolution of the pulsator of the receiving-machine at a point when the arm 16 is upon the non-conducting surface. Thereby the circuit through the pulsator is broken, but connected through the switch *l*, as aforesaid. The motors at the receiving station may continue to revolve, but are not operative. All the magnets *k* in the line are oper-

ated in unison by pulsations from the pulsator of the transmitting-machine, and in each machine the armature k' swings on the shaft 20 and operates the lever n, that carries the pawls 21 and stops 26, to the ratchet-wheel n', upon the shaft b of the type-wheel c; hence all the type-wheels will move around in unison with a step by-step motion, and when the pulsator at the sending station is stopped all the type-wheels in the circuit stop, and they stand at the same points.

I next proceed to describe how the pulsator is stopped at the sending station when its type-wheel and all others in the circuit are in position to have letter impressed corresponding to the finger-key d or d' that is acted upon. The type-wheel shaft carries a sleeve, o, with fingers 22 and 23 on opposite sides, and one below the other. The keys d d' being in semicircular ranges, each key has an arm below the bed A, extending radially toward the shaft b. The arms p are upon the keys d, and act with the fingers 22, and the arms p' are upon the keys d' and act with the fingers 23.

In the normal position the fingers 22 and 23 revolve clear of the arms p p', but when a key is depressed the arm of that key stops the finger 22 or 23 and sleeve o. In this sleeve o is an inclined slot with a pin, 24, from the shaft b therein, and a slight spring, 25, yields as the sleeve is stopped, and the shaft b continues to move sufficiently to give the sleeve o a downward movement by the pin 24 in the inclined slot, and by the lever o^2 lift the vertical sliding rod m and arm 16, stopping the pulsator and all the type-wheels, with the types corresponding with the depressed key in position ready for printing.

I next describe the means for giving the impression. The printing-lever t is upon the shaft r, that is operated upon by the armature r' of the electro-magnet q. The paper passes from the reel q' in front of the impression-pad, and then between the roller-segments s s' and clamps 32. These roller-segments are upon a stationary stud, 30, that is adjustable by the slotted frame and screw 31, and upon the respective roller-segments s s' are arms 33, carrying the feeding-clamps 32, and slotted ends to the arms 33 are acted upon by pins in the printing-lever t. The parts are in reverse position, so that one clamp acts to pull the paper along as the printing-lever moves one way, and the other clamp acts as the lever moves the other way, thereby moving the paper along each impression. By this arrangement the printing-lever acts to better advantage to swing the feeding-clamps than in the devices heretofore employed. A spring, 38, draws back the printing-lever. A circuit-closer, v, comes in contact with the type-wheel lever n every pulsation, but the contact is so instantaneous that the electro-magnet q has not time to act against its tension-spring to give the pulsation; but the moment the pulsator stops, and the type-wheel also stops by the circuit of the pulsator being broken, the contact of v and n closes the circuit from the screw 10 and bed of the machine through the lever n, closer v, lever v', insulated plate v^2, and wire to the magnet q, thence to the binding-screw 42, and this circuit may be part of the main line, or a local circuit at each station. The closing of this circuit gives the impression and feeds the paper, and also breaks its own circuit, for as the printing-lever comes up to give the impression the insulated arm x projecting from the printing-lever t moves the lever v' off the plate v^2, and breaks the circuit through the printing-magnet so that the printing-lever is instantly drawn back by its spring.

As soon as the operator at the transmitting station raises his finger from the depressed letter-key that key is raised by its spring, the sleeve o is turned back by its spring 25, the sliding rod m and arm 16 drop, and the pulsator is again revolved by its motor, and all the type-wheels start off upon their rapid step-by-step rotation in harmony, until another key is depressed and the operation is repeated. The arm 39 from the lever n replaces the switch-lever v' in contact with the plate v^2, the first movement of the lever of the type-wheel; hence the circuit-connection is restored ready for the next printing operation.

I claim as my invention—

1. A pulsator driven by friction and acting to make and break an electrical circuit in which are the magnets operating two or more type-wheels in unison, substantially as set forth.

2. The pulsator constructed substantially as set forth, in combination with a magnetic motor and the type-wheel and its magnet, substantially as set forth.

3. The pulsator g and its arm 16, in combination with the switch l and the metallic connections, substantially as set forth, for stopping the pulsator at the receiving station and completing the electric connections to the type-wheel magnets.

4. The type-wheel shaft b and type-wheel c, in combination with the sleeve o and its incline for giving an end movement to the sleeve when its rotation is arrested, substantially as set forth.

5. The arms 22 and 23 and sleeve o, in combination with the keys d d' and the pulsator stop 16 and pulsator g, substantially as and for the purposes set forth.

6. The feeding-roller segments s s' and pawls 32, arranged substantially as shown, and operated by the printing-lever t, acting upon the arms 33, substantially as shown.

7. The printing-lever magnet in an electric circuit that is closed by the movement of the lever that operates the type-wheel, substantially as set forth, so that the printing-magnet is brought into action by a pause in the rotation of the type-wheel.

8. The lever or switch v', in combination with the impression-magnet and printing-lever, substantially as set forth, for breaking

the circuit automatically to the printing-magnet.

9. The printing-lever t and magnet in combination with the type-wheel lever n, arms x and 39, and switch-lever v', substantially as and for the purposes set forth.

10. A type-wheel moved with a step-by-step movement, an electro-magnet for the same, and a pulsator, in combination with a secondary circuit to the printing-magnet operated automatically, substantially as set forth.

11. A series of printing-telegraph instruments arranged in one main electrical circuit and operated by the pulsator of any one machine in that circuit acting as a transmitter, and all the machines acting in harmony as receiving-machines, the pulsation in each receiving-machine being stopped or thrown out of action, substantially as set forth.

12. A printing-telegraph instrument containing a pulsator, type-wheel, type-wheel magnet, a switch, and letter-keys, substantially as specified, so as to act as a receiving or transmitting machine by the movement of the switch, as specified.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraph.

No. 123,006. Patented Jan. 23, 1872.

Fig. 1.

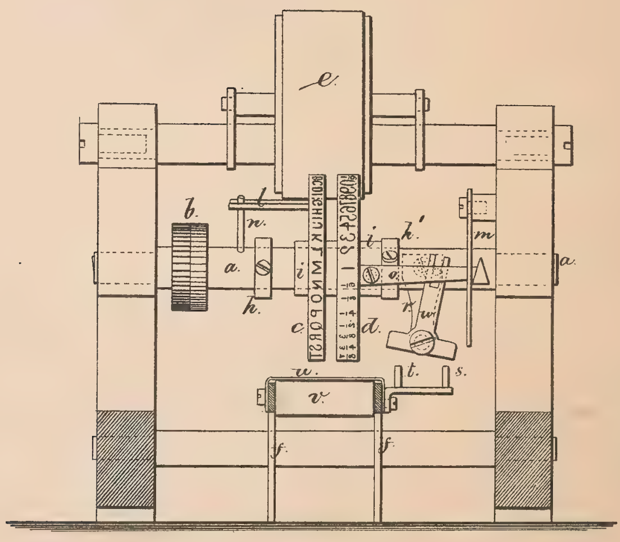


Fig. 2.

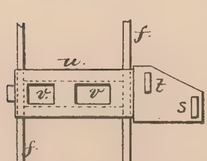
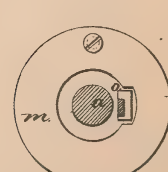


Fig. 3.



Witnesses

Chas. H. Smith

Harold Serrell

Thomas A. Edison

Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO "THE GOLD AND STOCK TELEGRAPH COMPANY," OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **123,006**, dated January 23, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In Letters Patent No. 113,034 a printing-telegraph is shown with a shifting pad that takes an impression from one of two type-wheels upon a shaft rotated by a ratchet and lever. My present invention is a modification of and improvement upon the said invention, and relates to devices for moving the type-wheel upon the shaft and thereby bringing one wheel into position for printing and throwing the other one out of action.

In the drawing, Figure 1 is an elevation of the said machine. Fig. 2 is a plan of the shield for the impression-pad, and Fig. 3 is the stationary guard-ring to prevent the type-wheels moving except at a given point.

The type-wheel shaft *a* is actuated by pawls, a lever, armature, and magnet, not shown in the drawing, but which may be of any desired or known character, the pawls acting upon the ratchet-wheel *b*. The type-wheels *c d* are inked by the drum *e*, as usual, and the impression lever *f* is operated by a magnet in the usual manner. The type-wheels *c d* are attached upon a sleeve, *i*, that slides freely upon the shaft *a*, and the extent of motion is determined by the collars *h h* or other stop, and there is either a feather or polygonal shaft to insure the rotation of the type wheels with the shaft, or else the projecting rods *l* are employed, passing at opposite sides of the arm *n* projecting from the shaft. I prefer this last-named device, as most free from friction. The arm *o* projects from the sleeve *i*, and has a V-cam at the end running at either one side or the other of the stationary ring *m*, and hence holding the wheels with the sleeve in contact with either the stop *h* or *h'*; but in this ring *m* is a notch that allows the V-cam to pass at the point where the type-wheel can be shifted. An arm, *r*, attached to the shaft *a* carries a T-lever, *w*, one arm of which is connected by a slot and pin with the arm *o*; the other arms are in the path of the finger *s* and *t* upon the printing-lever *f*. A shield, *u*, covers the impression-pad *v*, but has openings through which the impression can be made. If the type-wheel is turned so that the lever *w* is stopped over the finger *s* and then the impression-lever moved there will be no impression, there being a blank in the type-wheel at that point, and the finger will act upon the lever *w* and shift the type wheel so as to bring the other type-wheel into position over the opening in the shield, the shield preventing an impression from the other type wheel. The finger *t* acts in a similar manner when brought in contact with the lever *w* to shift the type-wheels to the position shown in the drawing. The portion of the shield between the openings *v v* coming beneath the type-wheel that is not in use prevents an impression therefrom.

I claim as my invention—

1. Two type-wheels fitted to slide endwise of their shaft, in combination with mechanism substantially as specified, to give such end movement to the said type-wheels, and a shield to prevent an impression from more than one of the type-wheels, substantially as set forth.

2. The lever *w* connected with the type-wheel shaft and type-wheels, in combination with the fingers that are moved by the impression-lever, substantially as set forth.

3. The stationary notched ring *m*, in combination with the type-wheels *c d* fitted to slide endwise of the shaft *a*, substantially as set forth.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

THOMAS A. EDISON. 2 Sheets--Sheet 1.

Improvement in Telegraph Apparatus.

No. 123,984. Patented Feb. 27, 1872.

Fig. 2.

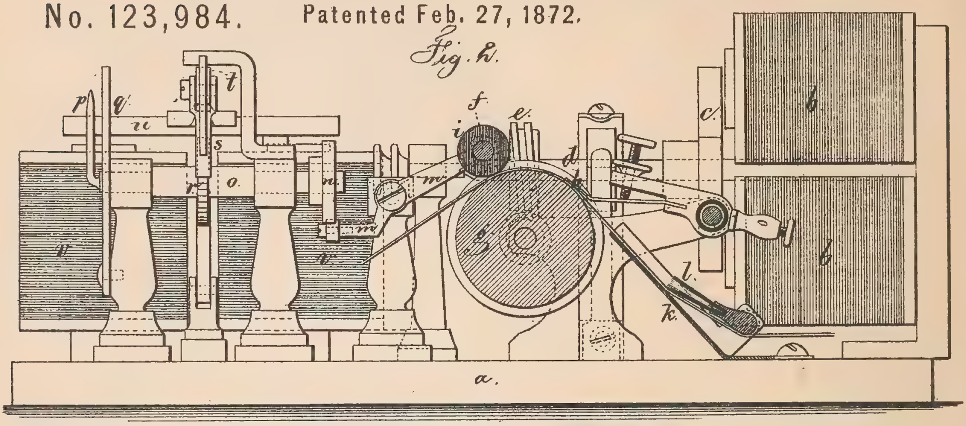
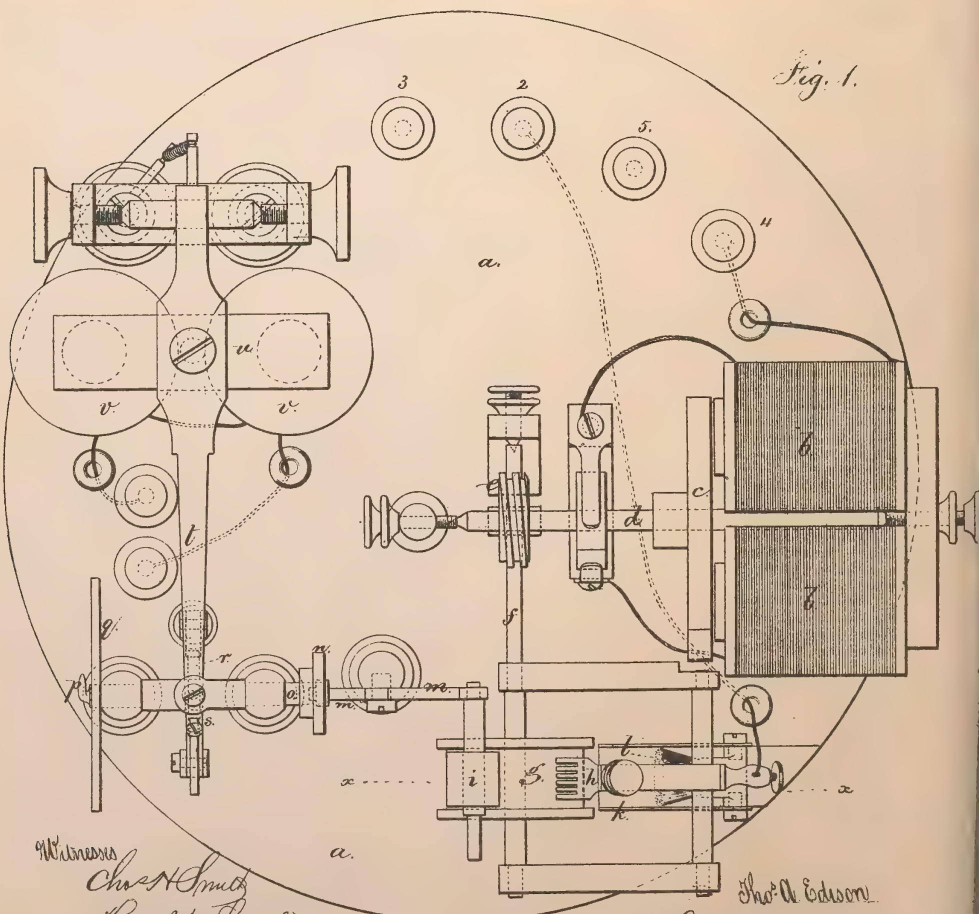


Fig. 1.



Witnesses
Chas H Smith
Harold Serrell

Thos A. Edison
L.W. Serrell
atty

N. PETERS. Photo-Lithographer, Washington, D. C.

THOMAS A. EDISON. 2 Sheets—Sheet 2.

Improvement in Telegraph Apparatus.

No. 123,984. Patented Feb. 27, 1872.

Fig. 3.

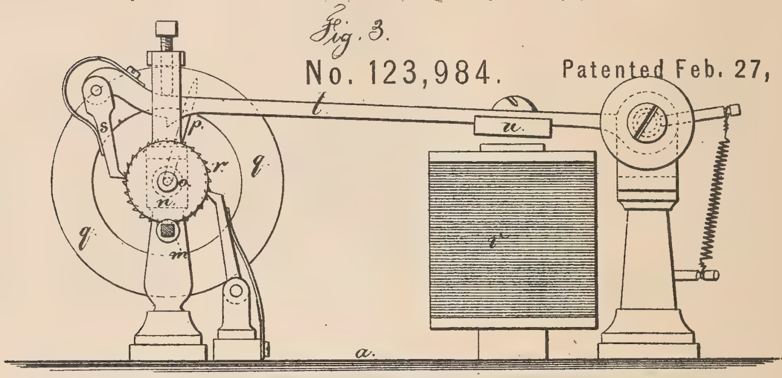
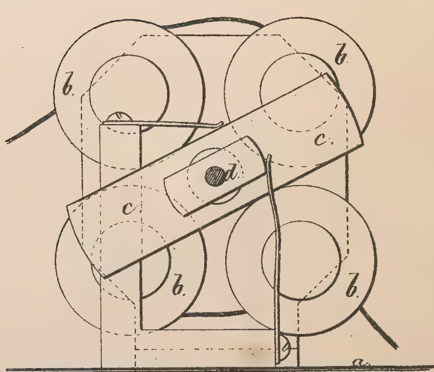


Fig. 4.



Witnesses

Chas H Smith

Harold Serrell

Thos A. Edison

Lemuel W. Serrell

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **123,984**, dated February 27, 1872; antedated February 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Apparatus; and the following is declared to be a correct description thereof.

The object of this invention is to give the operator at the sending station the opportunity to adjust the instruments on the line in such a manner as to bring into action the receiving instrument at any desired station independently of the operator at that station.

This invention is primarily adapted to the transmission of messages automatically by perforated paper, and their reception upon chemically-prepared paper; but the said invention may be employed in other telegraphic apparatus.

In the drawing, Figure 1 is a plan of the instrument complete. Fig. 2 is a section at the line *x x*. Fig. 3 is an elevation of the locking-wheel and its magnet, and Fig. 4 is an elevation of the motor.

The bed *a* is of suitable size, and carries the magnets *b b*, revolving armature *c*, shaft *d*, and worm-pinion *e*, forming a motor for the shaft *f* and transmitting or receiving roller *g*. *h* is the transmitting brush, roller, or pen, or the receiving stylus or pen is substituted for the same. The perforated paper or the receiving-strip passes through the trough *k*, and the brush *l* applies to the same the required friction to keep the paper in position. The binding-screws 2 and 3 are for the main-line wire, one connecting to the stylus and the other to the roller *g* through the metallic bed. The binding-screws 4 and 5 connect a local battery to the magnets *b b*.

I remark that the magnets *b b* and armature simply form a well-known motor for the machine, and that any other motor may be applied to revolve the roller *g*, and that this roller *g* and the parts connected therewith may be of any desired character and adapted to the automatic reception or transmission of telegraphic messages.

My special feature of improvement relates to an actuating mechanism applied to each machine, which, when brought into operation by the party at the transmitting station, causes the machine at the receiving station to become operative.

The roller *i* is mounted upon a lever, *m*, at the other end of which is a lock-wheel, *n*, having one notch. When this wheel *n* is turned around, so that the lever *m* or roller at its end passes into this notch, the roller *i* presses the paper upon the roller *g* by its own weight, or the force of a spring, sufficient to cause the paper to be drawn along between the rollers *g* and *i*; but when the roller *i* is raised by the circular portion of the lock-wheel *n* acting upon the lever *m*, the instrument is thrown out of action, and this movement of the lever *m* may also be made to switch the current away from its machine or direct it through the receiving or transmitting portions thereof. Upon the shaft *o* of this lock-wheel *n* is a hand, *p*, to the dial *q*, and also a ratchet-wheel, *r*, for the pawl *s* of the lever *t*. The armature *u* and magnet *v* are employed to actuate the ratchet *r* and lock-wheel *n*. This magnet *v* is in a separate main telegraph-circuit with a line-wire independent of that leading to the transmitting or receiving apparatus, or else it is placed in a shunt and the spring of the lever *t* set up, so that this apparatus will not be operative by the ordinary rapid pulsations in telegraphing. There are as many teeth in the ratchet *r* as there are stations on the line and on the dial *q*. The names or numbers of the stations are placed, and the position of the notch in the lock-wheel *n* is such in relation to the hand *p* that the notch will receive the lever *m* when the hand indicates the particular station; hence the operator at the transmitting station, by a dial or finger-key, turns his own pointer to the name or number of his own station, then holds the lever *t* by his hand or a lock, and proceeds to manipulate the key until the station is indicated to which the message is to be sent; all the dials in the line indicating that same station, only the instrument at that station will be locked into action by the lever *m* and roller *i*; and hence the machines at the transmitting and receiving stations are in position for the message to be sent and received. The strip of paper may be prepared with long perforations of the proper numbers at the commencement and end, so as

to move the lock-wheels of the instruments and determine the instrument at which the message is to be received, and the long perforations at the end of the strip will bring the lock-wheels and indexes around to the nonius or starting points.

In this manner the operator at the receiving station does not have to attend to the reception of the message, and the party at the transmitting station only has to set the dials, and, after sending the message, work his own instrument by hand around so that his index corresponds with the others in the line.

In place of long perforations for setting the instruments of the line, the speed of the transmitting motor might be made sufficiently slow to allow the pulsations to be of the required intensity.

I claim as my invention—

1. The lock-wheel n, lever m, and roller i, operated by an electro-magnet, substantially as set forth, for bringing into action the receiving instrument.

2. The roller g and transmitting or recording stylus or brush and the roller i, to press upon the paper and cause the movement thereof, in combination with mechanism, substantially as specified, for throwing the receiving instrument out of action by releasing the pressure of said roller i, as set forth.

3. A series of automatic telegraph instruments in one main telegraph-line, with locking mechanism and indicators, operated by electro-magnets, and arranged, substantially as set forth, so as to throw into action the desired receiving instrument, as specified.

Signed by me this 26th day of July, A. D. 1871.

T. A. EDISON.

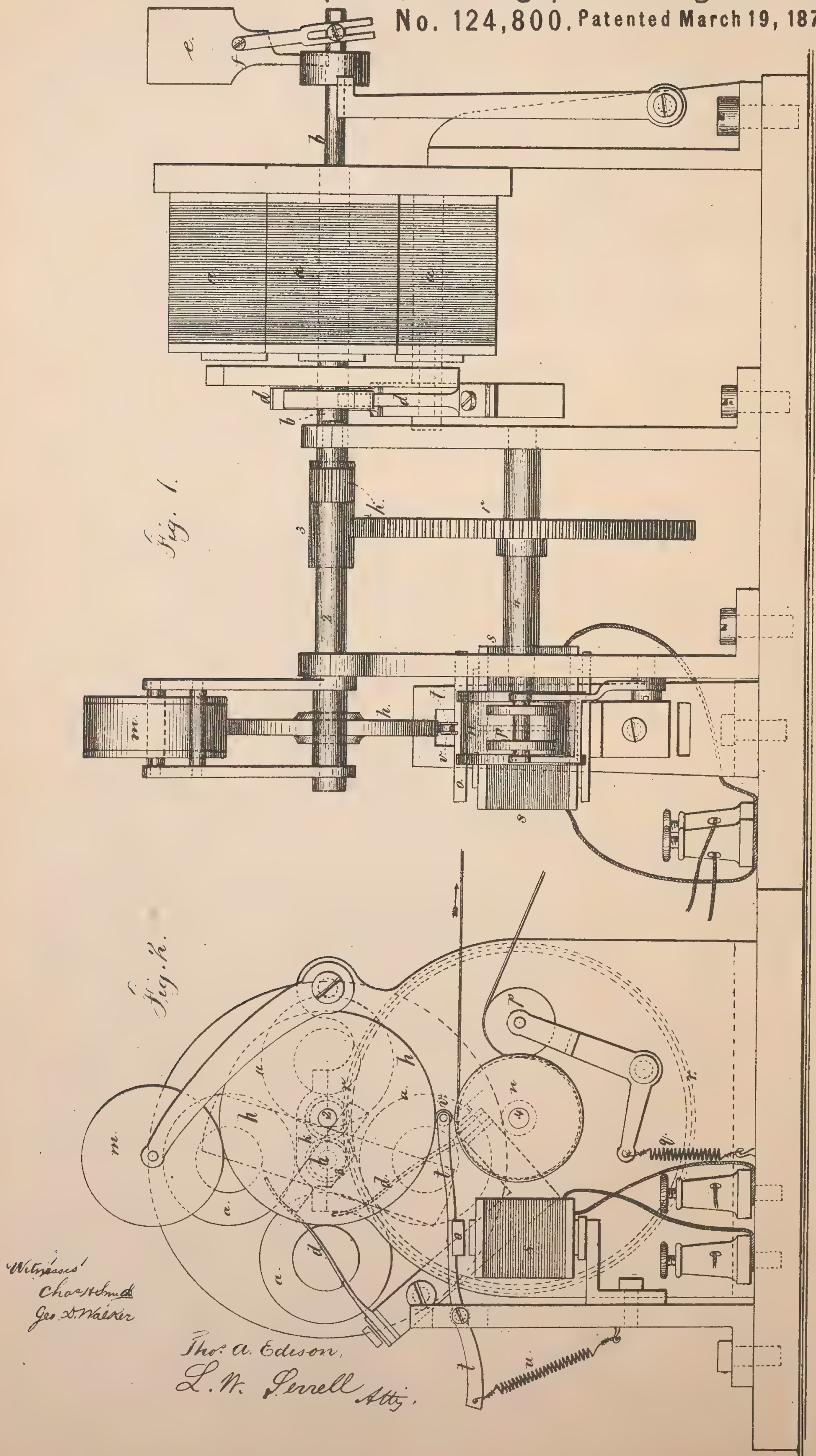
Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

T. A. EDISON. Improvement in Telegraphic Recording Instruments.

No. 124,800. Patented March 19, 1872.



UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPHIC RECORDING INSTRUMENTS.

Specification forming part of Letters Patent No. 124,800, dated March 19, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Ink Recording Instruments; and the following is declared to be a correct description thereof.

This invention is made for marking upon a strip of paper in dots and dashes in ink at the receiving-station to correspond with the message composed in a strip of paper by perforations, and employed for producing pulsations at the transmitting-station. The present improvement relates to a roller vibrated by a magnet between the paper and an inking-wheel, said inking-wheel moving with sufficient velocity to apply ink to the periphery of said roller when in contact.

In the drawing, Figure 1 is a side view of the motor and the parts moving the inking apparatus, and Fig. 2 is an elevation of the ink recording device.

The motor which I prefer and employ consists of four helices, *a a*, acting upon a revolving armature sustained by the shaft *b*, the electrical pulsations to the magnets passing through the circuit-closing springs *d d* from a local battery, and the fan *e* and point *f* acting to regulate the speed, as in my patent No. 111,112, granted January 24, 1871.

The inking-wheel *h* is driven at a rapid speed by the gearing *k* to the shaft 2, and said wheel *h* is in contact with the inking-drum *m*, that has an elastic surface, saturated sufficiently with ink to keep the edge of the wheel *h* in proper condition. This wheel *h* is, by preference, made of hard rubber. The strip of paper passes around the roller *n*, being kept in contact by the pulley *p* and spring *q*, and the roller *n* is driven at a sufficiently slow speed by the pinion 3 gearing into the wheel *r* on the shaft 4 of said roller *n*. The pulsations of electricity to be recorded pass through the electro-magnet *s*, either directly on the main line or through a branch circuit or local relay.

The armature *o* is upon the lever *t*, and the weight is balanced by a spring, *u*, or otherwise, and at the end of the lever *t* is the ink recording-roller *v*. In the normal position the spring *u* keeps this roller *v* in contact with the wheel *h*, but a pulsation of electricity in the magnet draws down the roller, making a mark upon the paper, and according to the duration of the pulsation so the ink-mark will be a dot or a dash. The periphery of the roller *v* should be of as great length as the longest dash, and the moment the magnetism ceases to hold down the roller *v* the same flies up into contact with the wheel *h* to receive more ink, and the speed of the wheel *h* should be such as to revolve the roller *v* once each time it comes in contact therewith, no matter how rapidly the pulsations are sent. An inking band might interpose between the roller *v* and paper, but I prefer the device shown.

I claim as my invention—

1. A roller raised and lowered by the action of an electro-magnet, and acting to impress ink upon a strip of paper in dots and dashes, substantially as set forth.

2. The inking-wheel *h*, in combination with the roller *v* and electro-magnet *s*, substantially as set forth.

3. The inking-wheel *h* and roller *v*, in combination with the electro-magnet *s*, for moving said roller *v*, and the magnetic motor for actuating the wheel *h* and paper-roller *n*, substantially as set forth.

Signed by me this 12th day of August, A. D. 1871.

T. A. EDISON.

Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Type-Wheels for Printing-Telegraphs.

No. 126,528. Patented May 7, 1872.

Fig. 1.

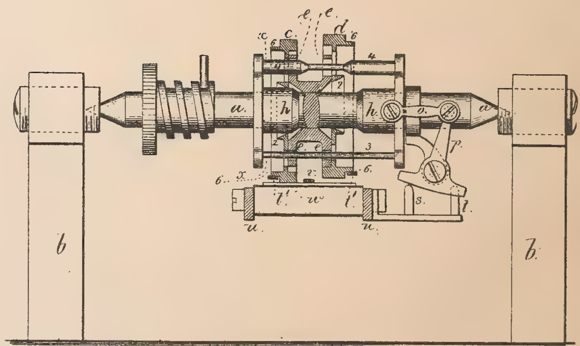


Fig. 2.

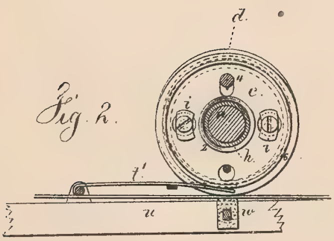
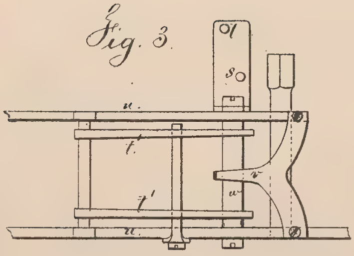


Fig. 3.



Witnesses
Chas H Smith
Geo. D Walker.

Inventor
Thos. A. Edison
Lemuel W. Serrell
att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN TYPE-WHEELS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,528, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs, and the following is declared to be a full and correct description of the same.

In an application for Letters Patent of like date herewith, the type-wheels of a printing-telegraph instrument are shown, constructed so that they can be expanded and contracted in order that the larger wheel may be printed from without impressing from the smaller or contracted wheel.

My present invention is a modification of the devices above mentioned; and the same consists of type-wheels with hubs fitting loosely upon the type-wheel shaft, but connected by screws and slots to disks secured to and revolving with said shaft. Conical-ended sleeves are also upon the type-wheel shaft, and they are arranged and operated so that when one sleeve is within the hub of one wheel, said wheel will be concentric with its shaft, and may be printed from; but the other sleeve will be out of the hub of its wheel, and allow a spring to act upon the lower portion of the wheel, and raise it sufficiently to prevent an impression while the other wheel is being printed from. A locking-bar, moving with the sleeves, locks the wheel, which is concentric with the shaft.

In the drawing, Figure 1 is an elevation of a type-wheel shaft with the wheels in section. Fig. 2 is a section at the line *x x;* and Fig. 3 is a plan of a portion of the printing-lever.

a is the type-wheel shaft, mounted in the side frames *b b*, and this shaft is to be revolved by a step-by-step motion, as usual. *e e* are disks secured to the shaft *a*, and revolving with the same; and to these disks *e e* the type-wheels *c d* are loosely connected by the screws and slots at *i i* that keep the type-wheels in contact with the disks, but allow of free lateral motion. Each type-wheel is made with a hub, 2, surrounding the shaft *a*, but of larger diameter, so that a conical-ended sleeve, *h*, may enter said hub to center the wheel and bring it concentric with the shaft *a*. There are two of these sleeves *h* upon the shaft *a*, and connected to each other by the rods 3 and 4, the latter being also a locking-bar to prevent any lateral movement of the wheel, which is concentric with the shaft *a*. This locking-bar is made with a small portion in the middle, so that it will allow the free movement of the wheel that is not locked, but will fill up the hole in the wheel that is locked, and thereby keep it in position. These sleeves are arranged as shown in Fig. 1, and are moved by the T-lever *p*, which is connected to one of the sleeves by the link *o*, and this lever *p* is moved by one of the pins *s t* on the upward movement of the printing-lever *u* when the type-wheel is at the blank point.

It will now be understood that when one of the type-wheels is upon its sleeve *h*, it is concentric with the shaft *a*, and may be printed from; the other wheel is off of its sleeve, and, if not otherwise provided for, would hang loosely upon the shaft and blur the paper when an impression was made from the other wheel. To prevent this I provide springs *t′ t′*, that may be secured to the printing-lever *u*, and these springs take against flanges 6 upon the respective type-wheels *c d*, and the wheel which is loose upon the shaft is kept up by the spring *t′* in the position shown in Figs. 1 and 2, so that the lower portion of the wheel is higher than the lower portion of the other wheel, and cannot make an impression upon the paper. A spring-finger, *v*, is employed to keep the strip of paper in contact with the impression-pad *w* and prevent blurring.

I claim as my invention—

1. The type-wheels *c d*, each connected to the disk *e*, but allowed to move laterally, in combination with the sliding sleeves *h h*, substantially as specified.

2. The locking-bar 4 and springs *t′ t′*, in combination with the laterally-moving type-wheels, substantially as and for the purposes set forth.

Signed by me this 23d day of January, A. D. 1872.

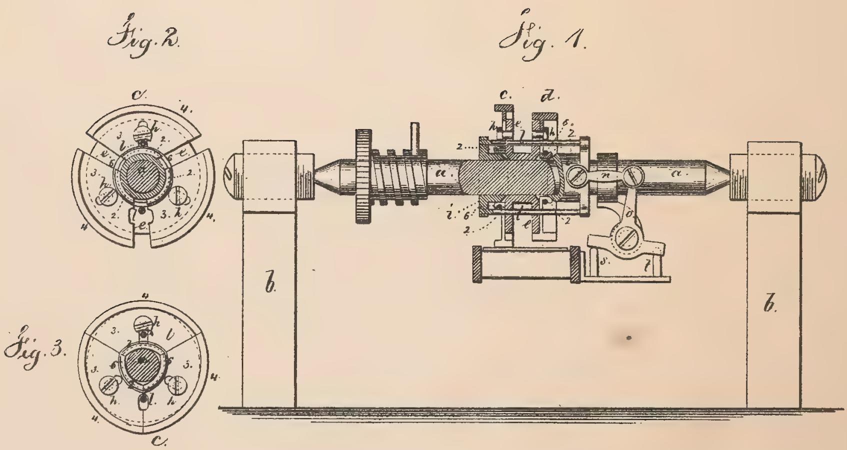
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Type-Wheels for Printing-Telegraphs.

No. 126,529. Patented May 7, 1872.



Witnesses
Chas H Smith
Geo. D Walker

Inventor
Thos A. Edison.
Lemuel W. Serrell
atty.

N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN TYPE-WHEELS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,529, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

In Letters Patent heretofore granted to me printing-telegraph instruments are shown with two type-wheels upon a revolving shaft and fitted so that either of them may be printed from without impressing from the other type-wheel—shifting type-wheels and shields are employed for this purpose.

My present invention is to accomplish the same object by the use of different means. I employ two type-wheels, each divided radially into sections and each section connected by screws and slots to a disk secured upon the type-wheel shaft so that the sections can be moved away from or toward said shaft to increase or decrease the diameter of the wheel. For this purpose I employ sleeves sliding freely on the type-wheel shaft and provided with conical ends to enter the divided hubs of the wheels, and said sleeves are arranged so that when one sleeve enters the hub of its wheel the other sleeve will be withdrawn from the hub of its wheel, by which means the first wheel will be increased in diameter and its periphery be concentric with its shaft and may be printed from, but the second wheel will be contracted in diameter and cannot impress the paper while the other wheel is being printed from.

In the drawing, Figure 1 is an elevation of a type-wheel shaft with the type-wheels in section. Fig. 2 is an elevation of a type-wheel as expanded, and Fig. 3 is a similar view of the wheel contracted.

a represents the type-wheel shaft, supported in bearings in the side frames *b b*, and this shaft is to be revolved by a step-by-step motion, as usual. *c d* are the type-wheels, each divided radially, as seen in Figs. 2 and 3, so as to form a sectional hub, 2, disk 3, and flange 4, the latter being provided with letters or numbers upon its outer surfaces. I have shown the type-wheels as each divided into three sections, and the sections composing the wheel *c* or *d* are connected by slots and screws *h h* to disks *e e*, which are secured to the type-wheel shaft and revolve with the same. The slots are radial with the shaft *a*, and the screws *h h* guide and limit the sections in their movement. *i i* are sleeves, sliding freely upon the shaft *a* and connected to each other by the rods *l l*, which pass through openings in the disks 3 3 and *e e*. Each of these sleeves is made with a conical end to enter the hub of the type-wheel and move the sections away from the shaft *a*, so as to increase the diameter of the wheel and make its periphery concentric with the shaft *a* so that the same may be printed from. These sleeves *i i* are arranged, as shown in Fig. 1, so that one sleeve is within its hub 2 and the wheel expanded, while the other sleeve is out of its hub and the wheel contracted by the rubber spring 6, which encircles the divided hub 2 and draws the sections toward the shaft.

To move the sleeves *i i* so that either wheel may be increased in diameter and printed from, I make use of the link *n* connected to one of the sleeves *i* and to a T-lever, *o*, which latter is moved by the pin *s* or *t* upon the upward movement of the printing-lever when the type-wheel is at the blank point. The pin *s* is slightly in advance of the pin *t*, and the operation of these pins and T-lever is the same as in my previous patents where the type-wheel or pad is shifted.

With a type-wheel constructed in three sections there will be three openings between the said sections, but the types may be close to the edges of these sections so as to be equidistant when the type-wheel is expanded.

The wheels are to be placed so that the sleeves may be shifted when a blank space is over the impression-pad, so that an impression will not be made when the sleeves are shifted by the upward movement of the printing-lever.

I claim as my invention—

The type-wheels, each divided into sections and connected to the disk *e*, in combination with the sliding sleeves *i i* for expanding the wheel, or allowing of its being contracted, for the purposes, and substantially as set forth.

Signed by me this 23d day of January, A. D. 1872.

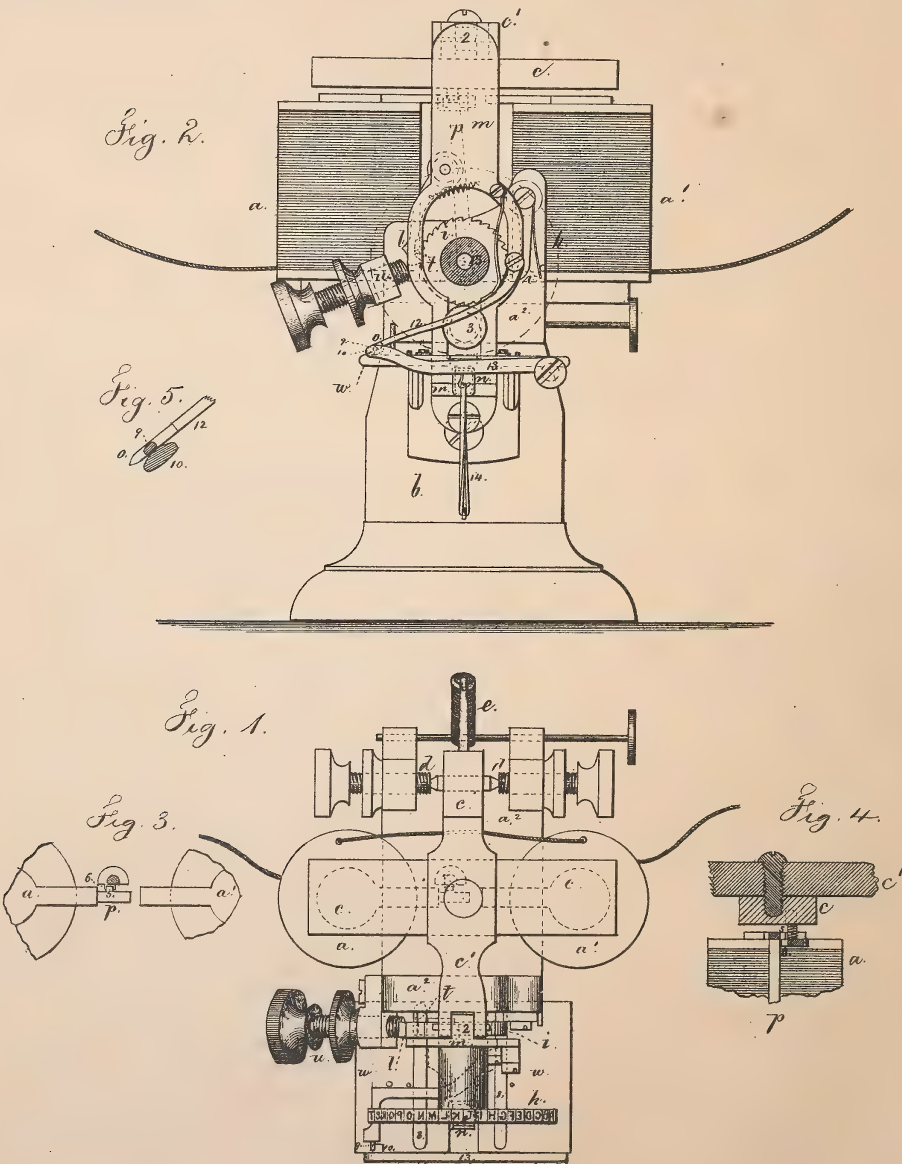
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,530. Patented May 7, 1872.



Witnesses

Chas H Smith

Geo. D. Walker.

Inventor

Thomas A. Edison

Lemuel W. Serrell atty

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **126,530**, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

My present invention consists of a printing-telegraph instrument in which the type-wheel is revolved and the printing and feeding mechanism operated by a movement communicated from the same armature of an electro-magnet. I make use of a type-wheel revolved by a step-by-step movement derived from the vibration of the armature of an electro-magnet, and between lateral arms from the cores of said electro-magnet is a swinging polarized bar, which, when attracted toward one of said arms by magnetism induced by a current of one polarity, allows the armature to be vibrated by pulsations of the same polarity and the type-wheel to be revolved; but a stop on said bar setting over a projection on the armature limits the upward movement of the armature and prevents the printing and feeding mechanism acting until the current is reversed, which then throws the polarized bar to the other pole of the electro-magnet, disconnecting the stop from the armature and allowing the same to have its full upward and downward movement to effect the printing and feed of the paper.

In the drawing, Figure 1 is a plan of my improved instrument. Fig. 2 is an elevation of the same with the type-wheel removed, but its position shown by dotted lines. Figs. 3 and 4 are detached views illustrating the device which limits the movement of the armature, and Fig. 5 is a sectional view of a portion of the feeding device.

The electro-magnet a a^1 is supported in a frame, a^2, upon the base b, and the armature c of said magnet is secured to the lever c', which swings upon the screw-centers d d. The spring e gives the upward movement to said lever c' and the parts connected to it. h is the type-wheel, upon a sleeve fitted to revolve freely on a gudgeon extending from the frame a^2, and to this sleeve is secured the ratchet-wheel i, which is turned, to rotate the type-wheel, by the pawl l pivoted upon the vertical bar m. This bar m is connected at its upper part by a joint, 2, to the lever c', which allows a free vertical movement to the bar, and it is guided by the pin and slot 3. This bar is made with an opening so as to pass around the gudgeon and sleeve of the type-wheel, and said bar carries the impression-pad n and paper-feeding dog or clamp o. p is the polarized bar between the lateral arms of the cores of the magnet a a^1, and it swings upon the center 15. At the top and upon one side of the bar p is a stop, 5, and upon the under side of the armature c is an L-shaped projection or stop, 6. When a pulsation of one polarity is sent through the magnet a the bar p is repelled from the core or arm of the magnet a^1, and attracted to the position shown most clearly in Fig. 3, where the stop 5 is immediately over the stop 6, and in this position the armature can be vibrated by pulsations of that polarity and the type-wheel revolved by the lever c', bar m, pawl l, and ratchet i, to bring the desired letter in position for printing; but an impression will not be made, because the stops 5 and 6 limit the motion of the armature and prevent the lever c' and connected parts receiving the full upward movement necessary for printing. When the polarity of the current is reversed the bar p is attracted by the magnet a^1, which disconnects the stops 5 and 6 and allows the spring e to give the full upward movement to the lever c', bar m, and impression-pad n, and effect the printing before the accumulation of force in the magnet a a^1 is sufficient to draw down the armature and feed the paper at the same time that the type-wheel is moved. The full downward movement of the lever c' and bar m actuates the dog o and feeds the paper the proper distance. The polarity of the current is now reversed, and the bar p will be moved to its normal position with the stop 5 over the projection 6; but there is sufficient play to allow the armature c to be vibrated so that the necessary movement is given to the lever c', bar m, and pawl l to rotate the ratchet-wheel i and type-wheel h as before. A pin, t, upon the frame a^2 takes against the under side of the pawl l and lifts it from contact with the teeth of i, when the full downward movement is given to the bar m, and prevents said wheel being turned more than one tooth by such

downward motion of the bar. *u* is a set-screw to determine the downward movement of the bar *m* and stop the rotation of the ratchet *i* and type-wheel *h*, and *v* is a pawl to prevent the ratchet *i* turning backward. The paper passes over the table *w* and beneath the spring-fingers 8 8, and in this table is an opening to allow the pad *n* to press the paper against the type-wheel and make the impression. The feeding-dog *o* is, at the outer end of an arm, 12, pivoted to the bar *m*, and at the side of this dog *o* is a pin, 9. When the type-wheel is being rotated the pin 9 slides up and down a yielding incline, 10, (see Fig. 5,) which keeps the dog *o* off of the paper; but upon the full upward movement being given to the bar *l* to effect the printing the pin 9 is moved up over the top of 10, and falls to the rear of said incline, bringing the dog in contact with the paper, and upon the full downward movement of the bar *m* the pin 9 slides under this incline 10, and the dog *o* feeds the paper forward the required distance. This incline 10 is at the outer end of an arm, 13, that is kept to the table *w* by the spring 14 so as to be raised by the pin 9 running beneath it, and then said pin 9 plays upon the surface of 10, keeping the dog *o* from contact with the paper while the type-wheel is being moved.

I claim as my invention—

1. The bar *p* and stops 5 and 6 to regulate the extent of motion allowed to the armature *c* of an electro-magnet, substantially as set forth.

2. A type-wheel rotated by a step-by-step motion and an impression-pad moved simultaneously, in combination with an electro-magnet and mechanism for regulating the extent of motion of the armature for moving the type-wheel or effecting the impression, substantially as set forth.

3. The yielding incline 10 and paper-feeding pawl *o*, brought into action by an increased movement of the armature of an electro-magnet, substantially as set forth.

4. An impression-pad moved by a spring to give the impression when the current is broken in an electro-magnet, in combination with a type-wheel, substantially as set forth.

Signed by me this 14th day of February, A. D. 1872.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

2 Sheets—Sheet 1.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,531. Patented May 7, 1872.

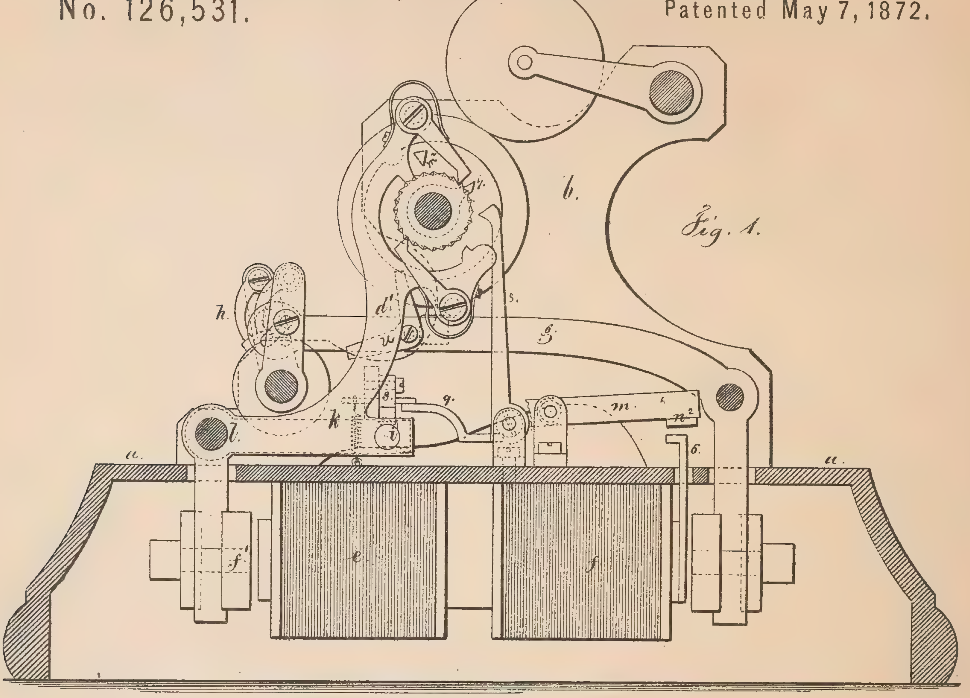


Fig. 1.

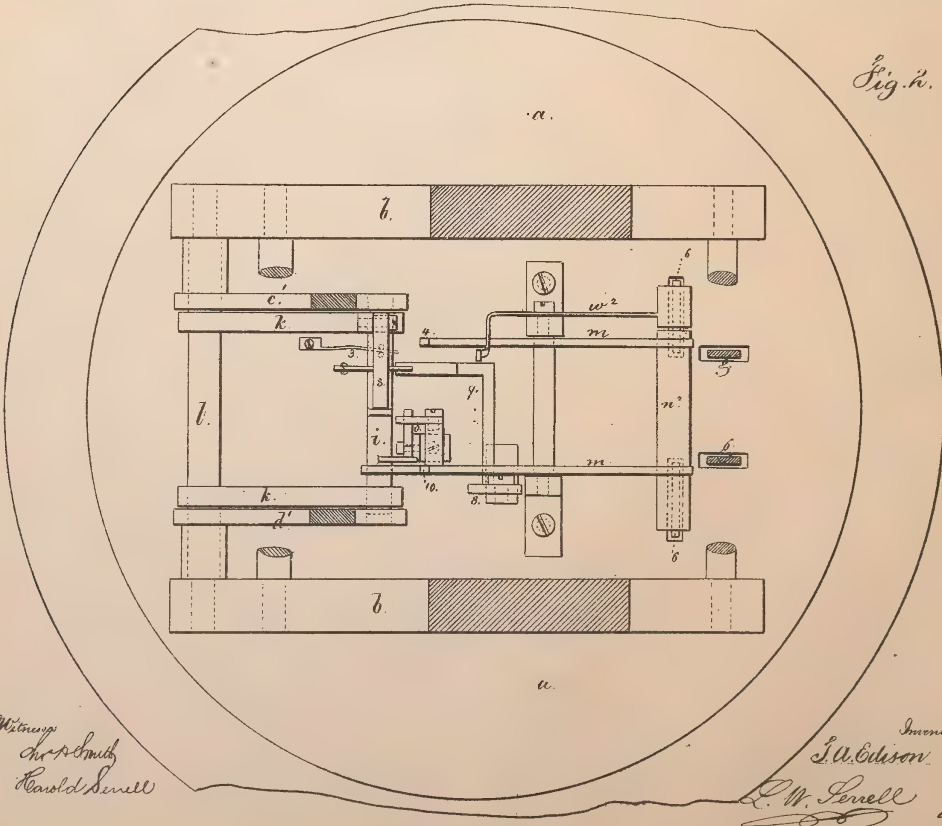


Fig. 2.

Witnesses
Chas H Smith
Harold Serrell

Inventor
T. A. Edison
L. W. Serrell
atty

N. PETERS, Photo-Lithographer, Washington, D. C.

2 Sheets--Sheet 2.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,531 Patented May 7, 1872.

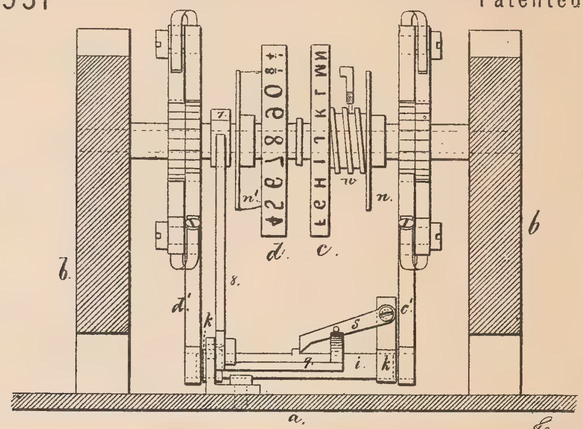


Fig. 3.

Fig. 4.

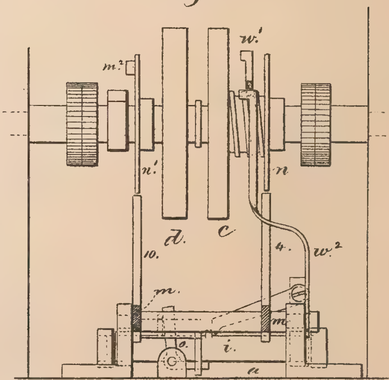
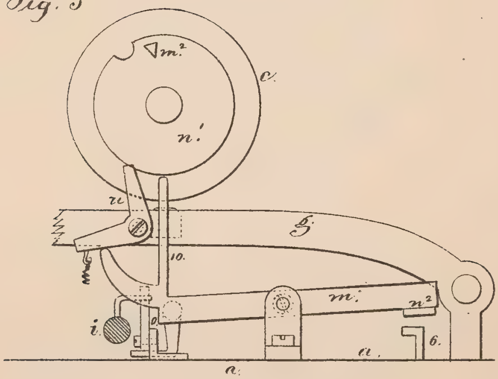


Fig. 5



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thos A. Edison

L. W. Serrell

atty.

N. PETERS. Photo-Lithographer. Washington D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **126,531** dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

This invention relates to mechanism operated by the printing-lever or magnet for moving a bolt that connects the type-wheel lever with one of two levers that give motion to one of two type-wheels by a step-by-step motion. In my present improvement a lever is acted upon by lateral cores from the printing-magnet, and this moves a bolt endwise, and the same is held by a latch. This movement can only be given at the time both type-wheels are at the zero or unison-points. The type-wheel that is locked by the bolt is revolved, and, as it moves the last step, in completing the revolution, the latch is unlocked, and the bolt drawn by a spring to unlock the connection to one type-wheel and lock the lever to the other type-wheel, and that can be operated and impressions taken therefrom until the printing electro-magnet is charged at the zero-point of both type-wheels, when the said bolt is shifted to lock the other type-wheel.

In the drawing, Figure 1 is a section vertically of the machine. Fig. 2 is a sectional plan with the type-wheels removed. Fig. 3 is an elevation of the type-wheels, levers, locking-bolt, and latch. Fig. 4 shows the screw-unison for the type-wheel and the levers thereof, and Fig. 5 is a side view of the bolt-actuating lever.

The bed *a*, frames *b*, type-wheels *c d*, type-wheel magnet *e*, impression-magnet *f*, printing-lever *g*, paper-feeding clamps *h*, and roller are similar to devices shown in patents heretofore granted to me, with the exception that the type-wheels are separate from each other, and actuated by independent step-by-step movements; and I remark that this improvement may be used with one line-wire and a polarized switch be employed to direct the current into either of the electro-magnets. The armature f' and its lever *k* swing on the fulcrum *l*, and so also do the levers c' d', and between these and their respective type-wheel shafts or sleeves are the usual ratchet-wheels, pawls, and stops, forming step-by-step movements, to rotate the type-wheel. These may be of any desired character. I make use of a bolt, *i*, sliding in the lever *k*, and connecting either the lever c' or the lever d' to said lever *k*, and hence moving whichever lever is so connected, and also the type-wheel with which it is employed. The spring 3 moves the bolt *i* into the lever c', except when otherwise acted upon. Hence the letter-wheel *c* will be operated in the usual manner, and must be brought to a zero or blank before the bolt can be unlocked from c' and bolted into d'. To insure this, the disk *n* is employed, with one notch in it, into which the arm 4 of the lever *m* can pass; but, at other times, this lever *m* will be kept from moving by the arm 4 taking the edge of the disk *n*. The lever *m* is actuated by an armature, n^2, contiguous to lateral poles 6 from the printing-magnet *f*. When this lever *m* is allowed to move, it acts upon the right-angle lever *o*, and slides the bolt *i*, drawing one end out of the lever c', and entering the other end into the lever d', and in this position it is held by a latch, *s*. The other type-wheel, which is the figure or character-wheel *d*, is now locked, and can be moved step by step. Upon the sleeve of this type-wheel *d* is a cam, 7, that, as the type-wheel is moved its last step to the zero-point, acts upon the lever 8 and its arm 9 to lift the latch *s* and allow the spring 3 to throw the bolt *i* the other way. The cam 7 then clears the end of 8. Hence, if the printing-magnet is charged at this time, the levers *m* and *o* will again throw the bolt into d', but otherwise the letter-wheel *c* will be rotated. When the type-wheel *d* is being rotated the lever *m* will not be fully moved when the printing-lever is being moved by its magnet, because the end of the arm 10 will take against the edge of the disk n^1, and this disk n^1 is notched, and the notch comes opposite this arm 10 when the type-wheel is at the zero-point. The bent lever *u* upon the printing-lever *g* is moved by the lever *m*, and thrown into the path of the stud m^2 upon n^1, and this is located so as to be moved by that stud as soon as the type-wheel *d* is moved. Thereby the lever m' will be moved downward, and the

arms 4 10 freed from the notches in n n^1 even if the armature should be attracted by any lingering magnetism in the electro-magnet f. The screw w on the type-wheel shaft, stop-lever w^1, and relieving-lever w^2, actuated by the lateral core of the electro-magnet f, are substantially the same as the parts shown in an application heretofore made by me for a patent, and allowed.

I claim as my invention—

1. The lever m and armature n^2, contiguous to the lateral poles 6 of the printing-magnet, for actuating the bolt i, in combination with the arm 4 and disk n, substantially as set forth.

2. The disconnecting-lever 8, operated by the cam 7, in combination with the lever m, armature n^2, the latch s, bolt i, and levers for the respective type-wheels, the parts being arranged and acting substantially as set forth.

3. The bent-lever u on the printing-lever, in combination with the stop m^2, lever m, and armature n^2, substantially as set forth.

Signed by me this 17th day of January, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets—Sheet 1.

T. A. EDISON.

Printing Telegraph.

No. 126,532. Patented May 7, 1872.

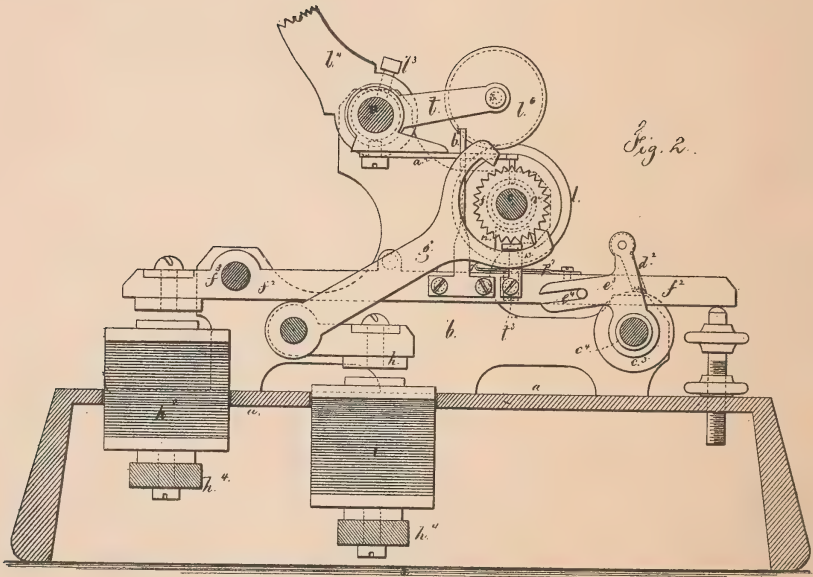


Fig. 2.

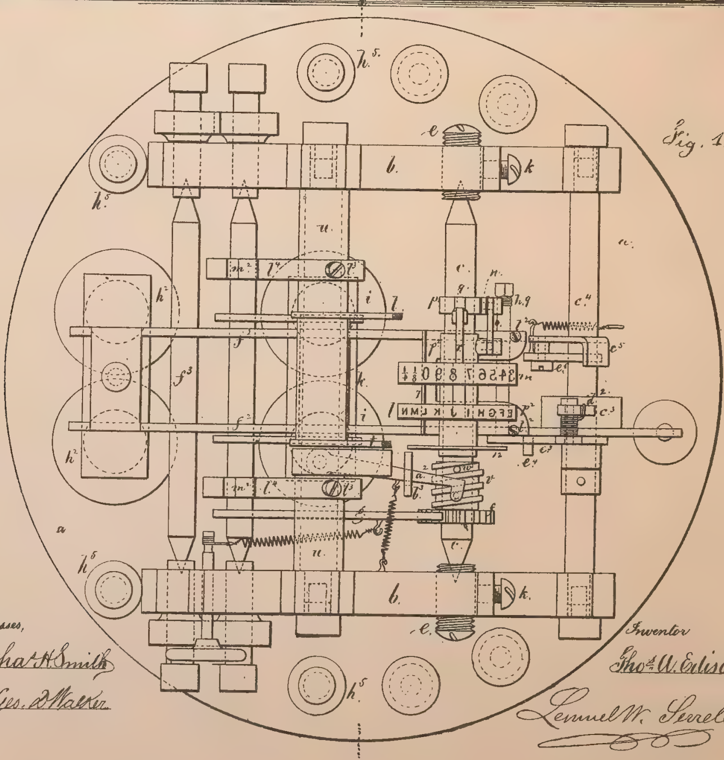


Fig. 1.

Witnesses,

Chas H Smith

Geo. D Walker

Inventor

Thos A. Edison

Lemuel W. Serrell

att.

T. A. EDISON.

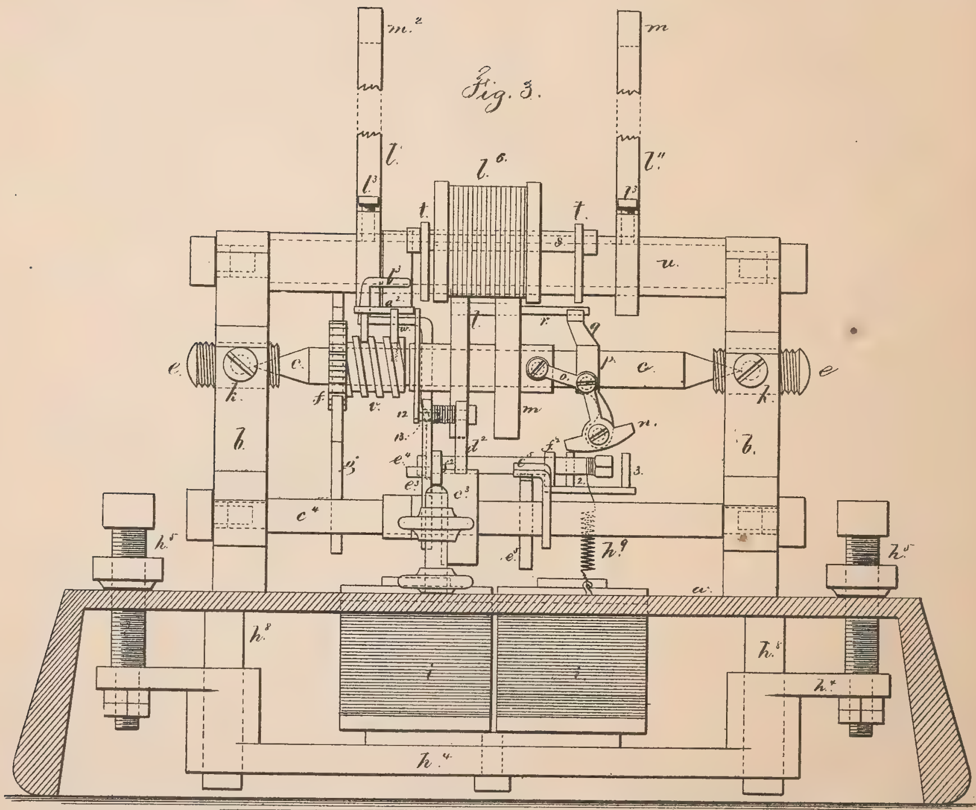
2 Sheets—Sheet 2.

Printing Telegraph.

No. 126,532.

Patented May 7, 1872.

Fig. 3.



Witnesses,

Chas H. Smith

Geo. D. Walker.

Inventor

Thos. A. Edison

Lemuel W. Serrell

att'y

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **126,532**, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made certain Improvements in Printing-Telegraphs, and the following is declared to be a full and exact description of the same.

In an application for Letters Patent dated July 26, 1871, and allowed August 18, 1871, a printing-telegraph instrument is shown in which two type-wheels are employed upon a revolving shaft, said type-wheels being upon a sleeve that slides upon the shaft, and is moved by a connection from the printing-lever to bring either type-wheel into position for printing. A shield between the paper and type-wheel is employed to prevent an impression from the type-wheel that is not in use.

In an application for Letters Patent dated November 13, 1871, and allowed December 15, 1871, a unison device is shown, consisting of a stop upon the type-wheel, a worm upon the type-wheel shaft, and a hinged and swinging arm, with one end resting on the worm, and operated by a connection to the impression-magnets, so that the swinging-arm is kept from contact with the stop upon the type-wheel except when these wheels are continuously turned for bringing all the machines in the line into unison, in which case the swinging arm comes into contact with said stop.

My present invention relates to modifications in the construction and arrangement of the parts employed in the before-named telegraph instruments, whereby the machine is rendered more compact, the parts adjusted with greater accuracy, and the working of the apparatus rendered reliable in all respects.

My improvements relate as follows: First, to the manner of mounting the type-wheel shaft in adjustable screw-bearings. Second, to shifting the type-wheels by a link and connections to the printing-lever. Third, to the ink-roller, made of disks of cloth or other woven material. Fourth, to the ink-roller fitted so that it can shift with the type-wheels. Fifth, to a pin inserted in the shaft to act as a stop for the unison arm to take against, instead of the stop being on the type-wheel. Sixth, to making the upper end of the unison tripper of a forked shape to limit the motion of the unison arm. Seventh, to the paper-feeding mechanism that operates upon the upward movement of the printing-lever, and a holding device to prevent back movement of the paper and allow of the printing being observed. Eighth, to the type-wheel and impression-magnets, sustained and adjusted with reference to their respective armatures. Ninth, to the arms for the paper-reels, affixed upon the cross-bar which sustains the ink-roller. Tenth, to the impression-shield, made as an open spring-plate to keep the paper in contact with the impression-pad and away from the type-wheel.

In the drawing, Figure 1 is a plan of the machine complete. Fig. 2 is a vertical section of the same; and Fig. 3 is an elevation of the apparatus with the bed in section at the line *x x*.

a is the bed of the machine, and secured to it are the side frames *b b*, of usual character. *c* is the type-wheel shaft, mounted in the screw-bearings *e e*, and revolved by the ratchet-wheel *f*, lever *g*, armature *h*, and electro-magnet *i*. The screw-bearings *e e* allow of the shaft *c* being adjusted longitudinally to accommodate the position of other parts; and to prevent the screws *e e* working loose by the jar or concussion of the apparatus I clamp them firmly by the screws *k k*, which enter the frames *b b* at right angles to the screws *e e*. The type-wheels *l m* are upon a sleeve sliding freely on the shaft *c*, and to shift said type-wheels so that either can be printed from I make use of the pins 2 3 upon the printing-lever to move the T-lever *n*. Instead of employing this T-lever to act by a slot and pin to move the sleeve as in the application for Letters Patent before referred to, I make use of a link, *o*, connected to the sleeve and lever *n*, by which a very easy motion is obtained, and one in which there is but little friction. The fulcrum of the lever *n* is upon an arm extending from the collar *p* upon the shaft *c*, and said collar is provided with a second arm, *q*, which acts as a guide for the pin *r* extending from the type-wheels, and insures the rotation of the type-wheels with the shaft *c*, and of their being kept in their proper position. The disk 12 and cam 13 prevent the type-wheels being accidentally shifted; these correspond to parts in before-named applications. The ink-roller l^6 is made

of a number of disks or washers of woven cloth, secured upon the hollow axis of the roller and between the heads thereof. The surface of the roller thus formed is dressed smooth by burning or otherwise, and such surface will wear smooth, and not become torn or injured by the sharp edges of the letters on the type-wheel, as is apt to be the case when the roller is formed of layers of cloth wound upon the axis of the roller. This roller is also much better than a roller formed of felt, because the fine fibers thereof are not closely connected together, and hence they wear off and clog the type-wheels. The ink-roller is upon the shaft s, that is supported by the arms $t\ t$ from the cross-bar u, and I make this shaft s of such length that the ink-roller may slide upon the same as it is moved by and with the type-wheels as they are shifted, and thus prevent the type-wheels scraping the ink from the roller, as they now do with the fixed roller.

The "unison" device is a worm, v, upon the shaft c, a stop, w, projecting from the shaft c, a hinged and swinging arm, a^2, and the tripper b^3, connected to or moved with the printing-lever. The operation of this unison is the same as in the application before referred to, except that the tripper is moved by the printing-lever, instead of by the printing-magnet, to bring the arm a^2 to its normal position away from the stop w; but I make the upper part of said tripper-bar b^3 of the forked form shown, so as to limit the upward and lateral movement of the arm a^2 and keep it in its proper position relatively to the worm v. To feed the paper along I make use of the roller c^3 upon the stationary shaft c^4, the feeding-pawl d^2, the slotted lever e^3, and the pin e^4, on the printing-lever f^2. The printing-lever f^2 is moved by its magnet h^2, as usual; but the position of the slotted lever e^3 and pin e^4 is such that the feed of the paper takes place during the upward movement of the printing-lever by the direct action of the printing-magnet through the printing-lever, and not by the action of a spring, as is the case when the paper is fed by the downward movement of the lever; consequently this spring h^9 can be made lighter, and not so much power will be required to operate the printing-lever. Upon the shaft or bar c^4 is a stationary arm and plate, c^5, and connected to this arm is the spring-holding pawl e^5. The paper (one side of the strip) passes under this plate, and is prevented from moving back by the pawl e^5, and as this plate requires to be but very narrow, it does not hide the printing upon the strip of paper, but leaves it visible at this point. The printing and type-wheel magnets $h^2\ i$ are each mounted in and connected to a yoke or frame, h^4, and said frame is suspended and adjusted by the set-screws and nuts $h^5\ h^5$. Guide-pins $h^8\ h^8$ are employed for guiding and steadying the frame h^4. This arrangement allows of the magnets being adjusted to suit the position of their respective armatures. $l^1\ l^1$ are arms secured to the bar u by the screws $l^3\ l^3$, and formed at their upper ends with the bearings m^2 for the shaft of the paper-reel. The paper-reel thus located is not in the way of other parts of the machine, and avoids the use of a standard or support for the reel separate from the machine itself. The shield p^2, which prevents an impression from the type-wheel not in use, is a three-sided or open spring-plate, as shown in Fig. 1, and connected by the screws $t^2\ t^2$ to the printing-lever. The paper passes from the paper-reel under the axis f^3 of the printing-lever, and thence beneath the rounded end 7 of said plate p^2 and over the impression-pad t^3, to the paper-feeding device, and this spring plate or shield keeps the paper in contact with the impression-pad and away from the type-wheel that is not in use; hence it prevents blurring of the paper by the type.

I claim as my invention—

1. The type-wheel shaft c, sustained at its ends in the screw-bearings e that are clamped by the screws k, as specified.

2. The link o and T-lever n, in combination with the type-wheels $l\ m$ and sleeve sliding on the shaft c, as set forth.

3. The inking-roller l^6, made of disks of woven cloth clamped between heads, as set forth.

4. The inking-roller sliding upon its shaft, in combination with the pair of type-wheels also sliding upon their shaft, as set forth.

5. The unison stop w, made of a pin passing into the type-wheel shaft, in combination with the worm v and swinging arm a^2, as and for the purposes set forth.

6. The unison tripper b^3, made as a fork, in combination with the arm a^2 and screw v, as and for the purposes set forth.

7. The paper-feeding mechanism, consisting of the dog d^2 and lever e^3, moved by the upward motion of the printing-lever and the holding-dog e^5, and acting near the respective edges of the paper, as set forth.

8. The type-wheel and impression-magnets, sustained and adjusted by the yoke h^4 and screws h^5 that pass up through the bed a, as set forth.

9. The arms t for the paper-reel, sustained upon and above the cross-bar u that receives the arms of the ink-rollers, as set forth.

10. The impression-shield, made as an open three-sided spring-plate, attached to the impression-lever, as and for the purposes set forth.

Signed by me this 3d day of January, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,533. Patented May 7, 1872.

Fig. 1.

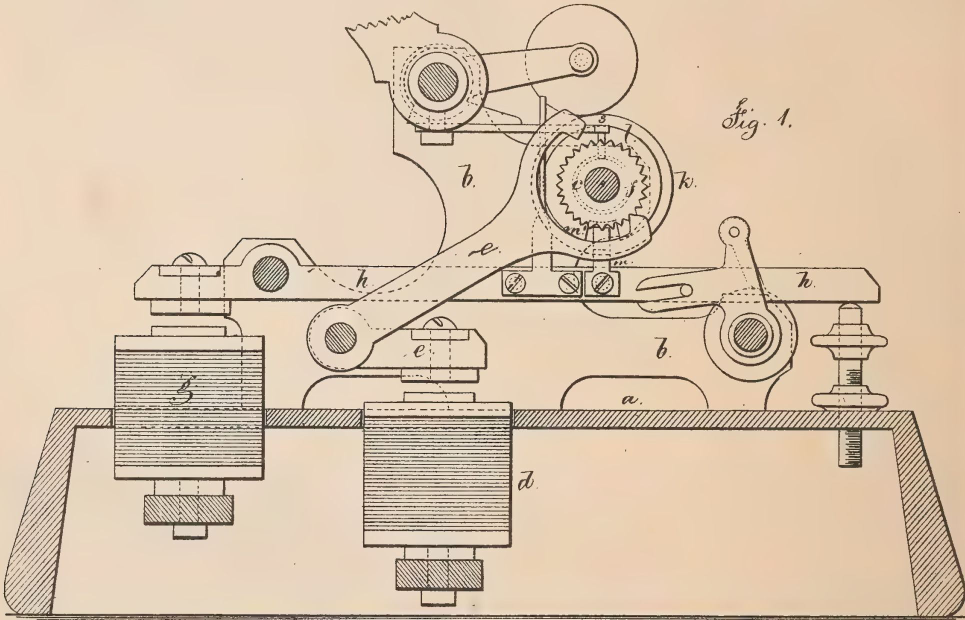


Fig. 3

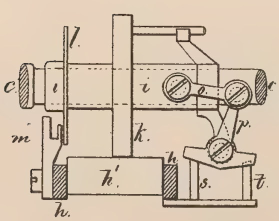
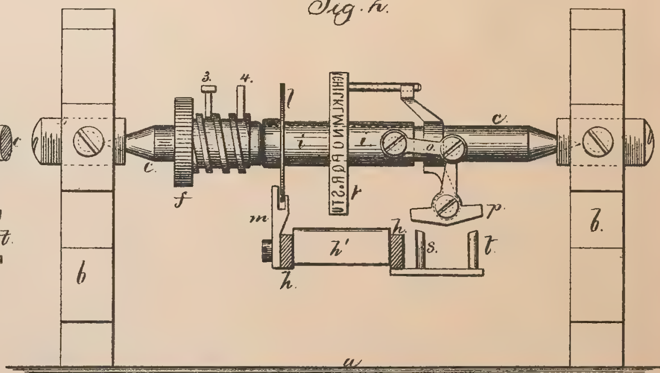


Fig. 2.



Witnesses

Chas. H. Smith

Geo. D. Walker.

Inventor.

Thomas A. Edison.

Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 126,533, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have made a new and useful Improvement in Printing-Telegraphs; and the following is declared to be a full and correct description of the same.

This invention relates to a printing-telegraph instrument of the same general character as that set forth in an application for Letters Patent dated January 3, 1872; and this improvement consists of a locking device for preventing any instrument in the circuit receiving an impression of a message being sent except that one which the operator at the transmitting-station unlocks and brings into unison with his own instrument.

In the drawing, Figure 1 is a vertical section of a printing-telegraph instrument with my improvement applied. Fig. 2 is an elevation of the type-wheel shaft and its parts, together with a portion of the printing-lever, said parts being in position so that an impression cannot be made from the type-wheel; and Fig. 3 is an elevation of the same parts in position for printing.

a represents the bed, and *b b* the side frames of the machine. *c* is the type-wheel shaft, revolved by a step-by-step motion derived from the electro-magnets *d*, armature and lever *e*, and ratchet *f*. *g* are the electro-magnets for the impression-lever *h*. These parts are all of usual character, as is also the paper-feeding device. *i* is a sleeve sliding freely upon the shaft *c*, but turning with it, and secured to this sleeve is the type-wheel *k*, and also a disk, *l*, with one notch, *m′*, in its periphery. (See Fig. 1.) Upon the printing-lever *h* is an arm, *m*, and the upper part of this arm is made as a fork to receive the edge of the disk *l* when the parts are in the position shown in Fig. 2, and in this position an impression cannot be taken from the type-wheel, because the edge of the disk *l* acts as a stop to limit the movement of the impression-lever and prevent said lever and its pad *h′* rising high enough for that purpose. When the parts are in the position shown in Fig. 3 the disk *l* is free from the fork of *m* and the instrument is in condition for receiving and printing a message. The mechanical means for shifting the sleeve *i* and its disk and type-wheel are the same as in aforesaid application for shifting the sleeve and type-wheel, viz., by a link, *o*, connected at one end to the sleeve *i* and at the other end to a T-lever, *p*, pivoted to an arm on the type-wheel shaft; and this lever *p* is moved by the pins *s* and *t* on the printing-lever to shift the sleeve in either direction; but the shaft *c* has first to be rotated until the notch *m′* in the disk *l* coincides with the arm *m* before said sleeve can be shifted. This notch *m′* is differently located upon each instrument.

I will now proceed to describe the manner in which the operator at the transmitting-station unlocks the desired instrument in the circuit and brings the same in unison with his transmitting-instrument; but it is first to be understood that all the type-wheels *k* have the same letters and correspond with those on the transmitting-dial, and also that there may be as many instruments in the circuit as there are letters upon said dial, and that each machine is known by a particular letter. The operator, by pulsations sent through the magnets *d*, first rotates all the type-wheel shafts until each shaft is arrested in its revolution by the arm 3 and stop 4; but the type-wheels are not in unison with each other nor with the transmitter, but stop on different letters—one on A, another on B, another on C, and so through the alphabet. If the operator now desires to unlock the C machine, he turns the hand of the transmitting-dial until it is over the letter C, and then closes the circuit, through the magnets *g*, so as to throw up the printing-lever *h* and disconnect the arm 3 from the stop 4 of each instrument and allow all the type-wheels to be revolved, when pulsations are sent through the magnets *d*. There is sufficient space between the edge of the disk *l* and the bottom of the notch or fork *m* to allow of the limited movement of the printing-lever necessary to operate the arm 3, but not sufficient to allow of an impression being made. The C machine (the machine which stopped at the letter C) is now in unison with the transmitter, and to unlock said disk *l* from the notch of *m* it is necessary to turn the hand of the transmitter to that part of the dial which indicates that the notch in *l* is over and in line with the fork *m*. When the hand is brought to this point

the circuit is to be closed through the magnets *g*, which moves the impression-lever and brings the pin *s* in contact with the T-lever *p*, moving the same so as to slide the sleeve *i* and free the disk *l* from *m*. The machine is now in condition for receiving and printing a message. When this machine is no longer required for use the operator turns the hand of the transmitter to that point which indicates that the notch in *l* coincides with the fork *m*, and, by closing the circuit through the magnets *g*, the lever *h* is raised, and the pin *t* shifts the sleeve and disk, and the machine is again locked. I prefer that the sleeve *i* be shifted by the pin *s* to unlock the disk *l*, when the current is closed, through the type-wheel magnets *d*, and locked by the pin *t* when the circuit to said magnets is open. The disk *l* and type-wheel may be fixed upon the shaft and the stop *m* moved transversely of the printing-lever, the stops *s* and *t* projecting from the type-wheel shaft. The type-wheels might be all set at unison with each other, and the disk *l* and shifting devices changed to different positions, so that they all could be unlocked and the message sent to all the machines, which is not the case now.

I claim as my invention—

1. A locking mechanism, actuated by the movement of the printing-lever, for preventing an impression, in combination with the type-wheel and its actuating mechanism that controls the movement of the said locking mechanism.

2. A type-wheel and unison mechanism, in combination with a locking and unlocking mechanism for preventing or allowing an impression, substantially as specified.

Signed by me this 14th day of February, A. D. 1872.

T. A. EDISON.

Witnesses:

CHAS. H. SMITH,

GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,534. Patented May 7, 1872.

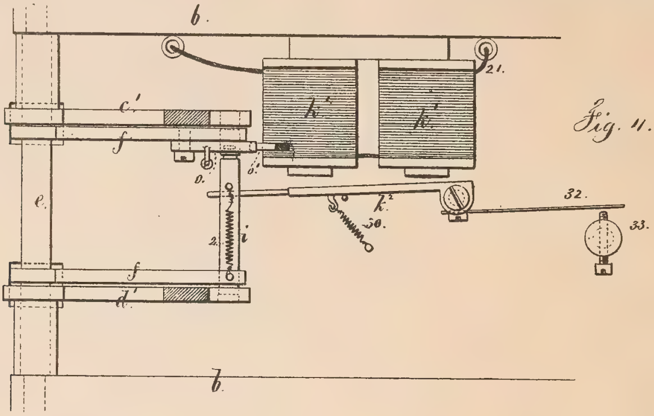
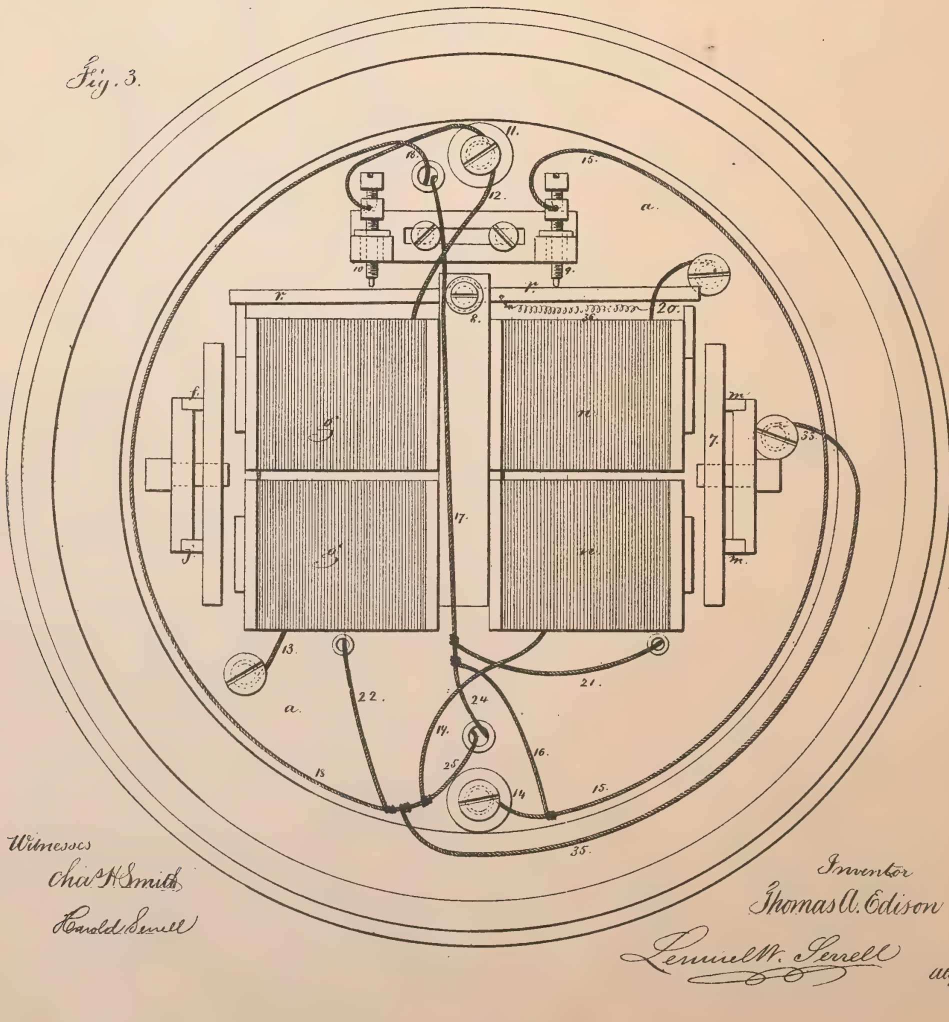


Fig. 11.

Fig. 3.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty

2 Sheets--Sheet 1.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,534. Patented May 7, 1872.

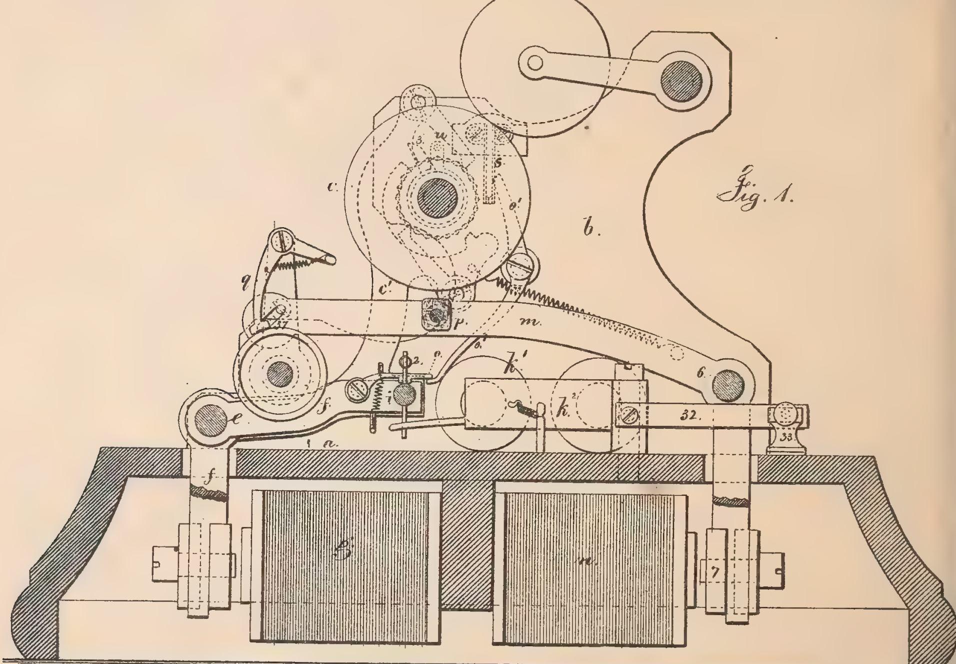


Fig. 1.

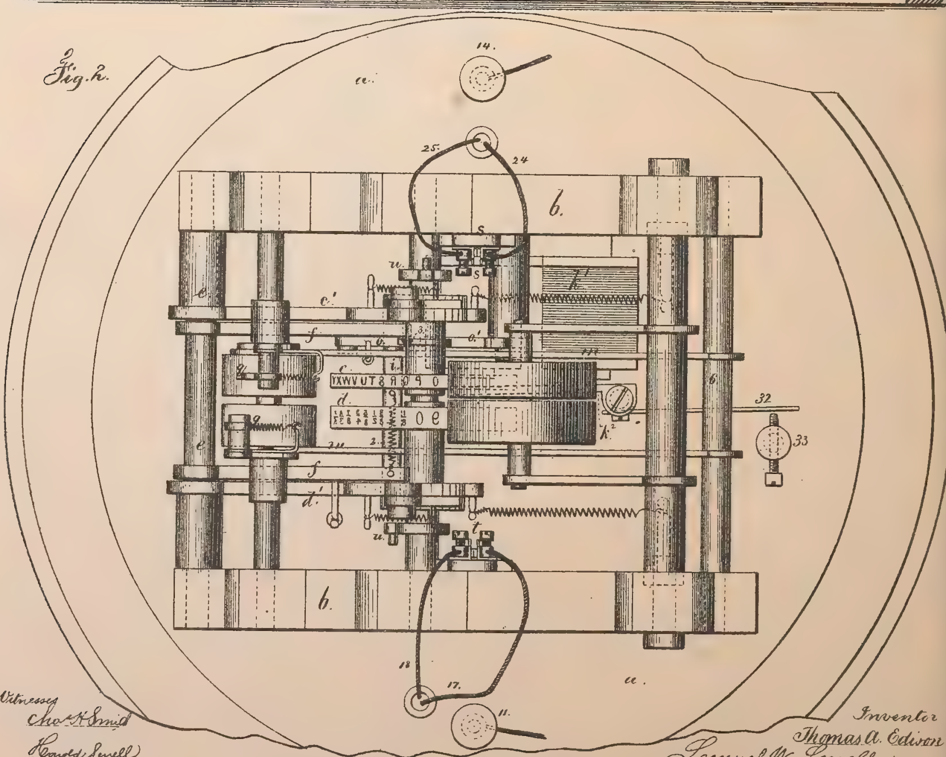


Fig. 2.

Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **126,534**, dated May 7, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

This telegraph is made for printing from one of two type-wheels. The type-wheels are contiguous, and revolved by separate ratchets and pawls, or step-by-step motions, and a magnet is employed to operate a bolt that connects one of the step-by-step movements with the lever and armature of an electro-magnet, and a latch holds the parts thus connected. This latch is lifted every rotation of the locked letter type-wheel, hence is unlocked, and a spring causes the bolt to connect the armature-lever to the step-by-step motion of the number or character wheel, hence that will be rotated; but should it be desired to continue the rotation of the letter-wheel, a pulsation of opposite polarity operates in the impression-magnet, and through a connection to the locking-magnet, and relocks the letter-wheel and disconnects the figure-wheel. At all times, except when the letter and figure wheels are at the zero or nonus points, the locking-magnet is prevented from acting when an impression is made by a circuit-closer that gives a shorter and more direct route for the electricity, and hence cuts out the locking-magnet. This circuit-closer is opened by a non-conducting arm revolving with the type-wheel at the zero point.

In the drawing, Figure 1 is a vertical section of the instrument. Fig. 2 is a general plan. Fig. 3 is an inverted plan; and Fig. 4 is a plan of the locking-magnet, bolt, and levers.

Upon the bed *a* are the frames *b b*, sustaining a shaft that carries the type-wheels *c* and *d*, the type-wheel *c* having letters, and the wheel *d* figures and fractions, or other characters adapted to the use for which the instrument is intended. The lever c' is provided with the necessary pawls and stops to act upon the ratchet of the letter-wheel *c*, and move the same with a step-by-step motion, and d' is the lever, with similar devices to form a step-by-step motion for the figure-wheel *d*. These step-by-step motions, being of ordinary character, do not require further description. The levers c' d' move upon a fulcrum or shaft, *e*, which is also the axis for the lever *f*, and armature of the electro-magnet *g*, designated herein the type-wheel magnet. The bolt *i* slides in the lever *f*, and when moved toward the lever d' by the spring 2, that end of the bolt *i* connects the lever d' with *f*, and they move together, and the lever c' is disconnected. When the bolt *i* is moved the other way the lever d' is disconnected from *f* and the lever c' connected by the other end of *i*, and in order to hold the bolt *i* a latch, *o*, is employed that springs into a notch in *i*. A lever, o', beneath the end of the latch *o*, extends upward contiguous to a cam, 3, moving with the type-wheel *c*, so that at each revolution of *c* the latch *o* is lifted and the bolt *i* drawn from c' by the spring 2. The bolt *i* is moved toward c' by the armature *k* of the locking-magnet k^1. The printing-lever *m* moves upon the fulcrum 6, and carries the armature 7 of the printing-magnet *n*. The impression-pad *p*, feeding-clamps *q*, and actuating cam-slots 37 are of any usual character. The polarized circuit-changer *r*, swinging upon the fulcrum 8, and moved into contact with the circuit screw-connections 9 and 10, according to the polarity of the current, is substantially similar to devices shown in patents heretofore granted to me, in which the current is directed either through the printing-magnet or else through the type-wheel magnet, according to its polarity. The spring circuit-closers *s* and *t* are near the type-wheel shaft, and upon the sleeves or shafts of the respective type-wheels there are arms *u*, with non-conducting pins projecting from the sides, and passing in their revolution between the ends of the circuit-closing springs *s* or *t*, respectively, and opening them break the circuit, and these pins and arms are located so as to separate these springs *s t* when the type-wheels arrive at the zero points. The line-wires connect with the binding-screws 11 and 14.

The operation of this instrument is illustrated as follows: Suppose letter-wheel *c* at zero point and the circuit-springs *s* separated, and the bolt *i* connecting *f* and d', the pulsation of electricity entering by 10 goes by wire 12 to magnet *g*; thence, by wire 13, to bed *a*, and by 8 and *r* through 9, wire 15, and to the line-screw 14. The pulsations, therefore, will act in the magnet *g* upon the step-by-step mo-

tion to set the wheel d. When the polarity of the current is reversed to effect the printing, the same enters at 14, passes through wires 16 and 17, springs t, wires 18 and 19, to the printing-magnet n; thence, by 20, to bed a, and by 8, r, and 10 to the line-wire from 11. To operate the letter-wheel c it is necessary to move the wheel d to the zero point, breaking the circuit at t; then reverse the pulsation, which then cannot go by 16, 17, 18, 19, &c., as before, because t is open; but it has to pass through 21 to the locking-magnet k', which throws the bolt i, unlocking d' and locking c'. The pulsation then goes, by 22, 19, through n, 20, a, 8, r, 10, and 11. The latch o holds the bolt i, and upon reversing the polarity of the current the letter-wheel can be moved around by the step-by-step motion and the printing done as before; but the pulsations in the type-wheel magnet pass from 11 through 12, g, 13, a, 8, r, thence by 9 and 15 to 14. When the impression is made on the letter-wheel c the pulsation comes through 14, 16, 24, 25, 19, n, 20, a, 8, r, 10, to 11, and if the letter-wheel c is to be revolved more than once, a reverse pulsation must be made upon the arrival of c at the zero point, because the cam 3 has in its last step unlatched o and allowed the spring 2 to draw the bolt i back from c'. This pulsation, as it cannot go through either s or t, has to go through the magnet k^1, and, by the armature k^2, move and relock the bolt i to c'. In order to prevent the armature k^2 remaining in contact with k^1 by any residual magnetism, I make the movement of the armature close the circuit between 32 and the insulated screw 33, so that there is a connection made from 22 through 35, 33, 32, to the bed a. The circuit at 32 33 is again broken as the armature is drawn back by the spring 30. A fine wire, 36, between r and 20, prevents the circuits being broken if the polarized switch r should not touch either 9 or 10. The locking-magnet k^1 might be operated by a separate line-wire; and either of the circuit-springs s or t may be employed with the pin on the type-wheel shaft for cutting out an electro-magnet, or compelling the circuit to pass through the same when the non-conducting pin intervenes between the springs.

I claim as my invention—

1. Two type-wheels, actuated by separate levers and step-by-step movements, in combination with an actuating electro-magnet, armature, and bolt that locks either of the levers with the actuating-armature, substantially as set forth.

2. An electro-magnet for operating the locking-bolt, in combination with the said levers, step-by-step movements, and type-wheels, substantially as set forth.

3. The latch o for holding the bolt i unlatched by the cam 3 upon the type-wheel shaft, in combination with the armature and levers to actuate the type-wheels, substantially as set forth.

4. The circuit-closing springs s or t, separated by the non-conducting pin upon the type-wheel shaft, in combination with an electro-magnet for directing the pulsation through that magnet when the pin is between the springs, substantially as specified.

5. The arrangement of circuit-connections, substantially as set forth, for actuating either of three electro-magnets in one main telegraph line, for moving one of two type-wheels and effecting the printing, substantially as set forth.

Signed by me this 17th day of January, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. D. WALKER,

GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 126,535. Patented May 7, 1872.

Fig. 4. Fig. 1.

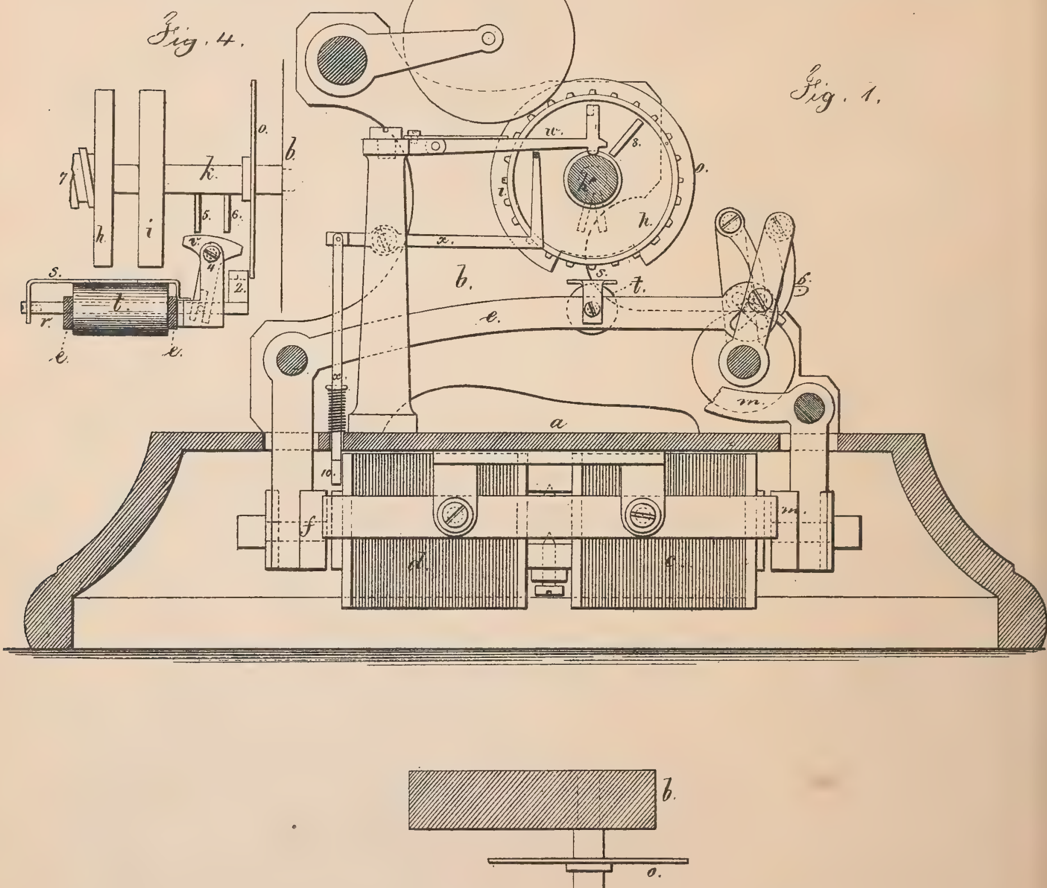
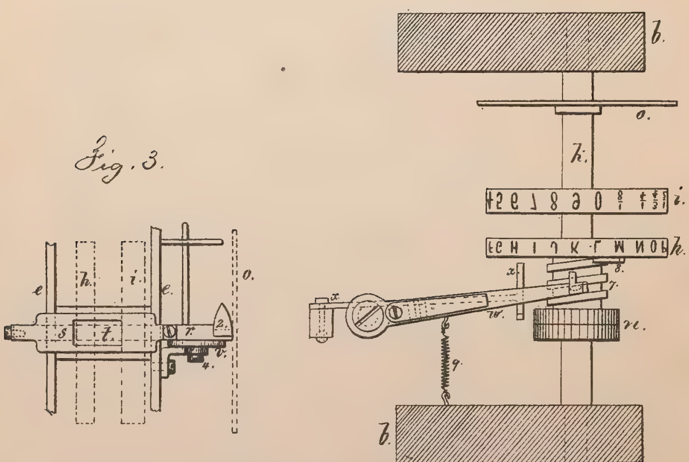


Fig. 3. Fig. 2.



Witnesses,

Chas H Smith

Geo D Walker

Thos. A. Edison,

Lemuel W. Serrell atty

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **126,535**, dated May 7, 1872.

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In my present invention I make use of two type-wheels, revolving with their shaft, and employ an impression-pad with a sliding shield, in which is an opening. This shield can be changed at certain points in the rotation of the type-wheel, so as to allow the impression to be made from one of the type-wheels through the opening in the shield, while the other is prevented from impressing the paper by the intervening shield. I also make use of an unison mechanism that is brought into action by two or more rotations of the type-wheels, but thrown out of action by the act of moving the pressure-lever or charging its magnet. By this means, if pulsations are sent through the line sufficient to rotate the type-wheels twice or more times without an impression being taken, the type-wheels will be moved around until the stop is operative, and then the same will be stopped and the pulsations may be continued, for the purpose of bringing into unison other type-wheels, in the same electric current, that may not be correctly set; and as soon as the circuit is reversed, or the impression or other magnet charged, all the unison devices in the circuit are simultaneously liberated; and this unison mechanism is not operative each rotation of the type-wheel; hence, as an impression is usually made each rotation, or nearly so, of the type-wheel, the unison mechanism will not come into play except when the rotation is continued for effecting that unison.

In the drawing, Figure 1 is a vertical section of my instrument. Fig. 2 is a plan of the type-wheels and unison; Fig. 3 is a plan of the pad and shield; and Fig. 4 is an elevation of the device for moving said shield.

The bed *a*, frames *b b*, type-wheel magnet *c*, impression-magnet *d*, and the connections to the main line are to be of any desired character; and where the printing-magnet is made operative by reversing the polarity of the current, the devices for directing said current may be such as shown in patents heretofore granted to me. The impression-lever *e*, armature *f*, and feeding-clamps *g*, for the paper, may also be of any desired character. The type-wheels *h i* are upon the shaft *k*, and they are moved by a step-by-step movement actuated by the armature *l* and lever *m*. *n* is the ratchet-wheels for the pawls on the lever *m;* these parts do not constitute any part of my present invention. Upon the shaft *k* is a disk, *o*, revolving with such shaft, and notched at one side; and upon the impression-lever is a slide, *r*, carrying the shield *s* above the pressure-pad *t*. Upon the end of the slide *r* is a cam, 2, that can pass through the notch in the disk *o;* but this can only be done when the type-wheel is at a certain point; hence the shield *s* will be held by this cam and slide, with the opening in such shield under one or other of the type-wheels. A T-shaped lever, *v*, is mounted upon a pivot, 4, upon the lever *e*, and, by a slotted end, acts upon this slide *r;* and there are two pins, 5 and 6, projecting from the shaft *k* and contiguous to this T-lever *v*, so that, if the impression-lever is moved when one pin, 5, is over said lever *v*, the slide and shield will be moved one way; and if the type-wheel is turned one space further, so as to bring the other pin, 6, over this lever *v*, the movement of the slide and shield will be the other way; hence the operator can bring the shield so as to print from one wheel or the other by simply rotating the type-wheels around to the proper point, and then giving motion to the impression-lever. There is a screw-thread, 7, upon the shaft *k*, and a tooth upon the lever *w* takes therein; there is also a block or stop, 8, upon the type-wheel. The spring 9 draws the lever *w* away from 8 each time the tooth is lifted out of the screw 7; hence, according to the number of turns of the screw-thread so the type-wheels will have to be rotated before the end of the lever *w* will be brought up far enough to arrest the stop 8; and each time the lever *w* is raised, it is drawn back to the beginning of the screw-thread; hence, if there is a connection between *w* and the impression-lever, or the impression-magnet, the stop 8 and lever *w* will not come into contact when the instrument is being employed in printing; but when the pulsations are contin-

ued through the type-wheel magnet, all the type-wheels in the circuit will be stopped at the same point, as before mentioned. The lever x and armature 10 at the side of the core of the magnet, form a convenient means for lifting the lever w and its tooth out of the screw 7; and this may be made to operate by a feeble pulsation, so as not to move the impression-lever.

I claim as my invention—

1. The sliding shield actuated by the T-lever v and pins 5 and 6, on the shaft k, in combination with the two type-wheels, substantially as set forth.

2. The revolving disk o and the cam 2, in combination with the shield s and type-wheels, substantially as set forth.

3. A unison stop actuated by a screw upon the type-wheel shaft, substantially as set forth.

4. The lever x and armature 10, at the side of the core of the magnet d, in combination with the unison-lever w, for moving the same, substantially as specified.

Signed by me this 13th day of November, A. D. 1871.

T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

THOMAS A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,131. Patented June 18, 1872.

Fig. 3.

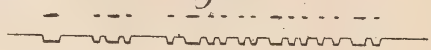


Fig. 2.

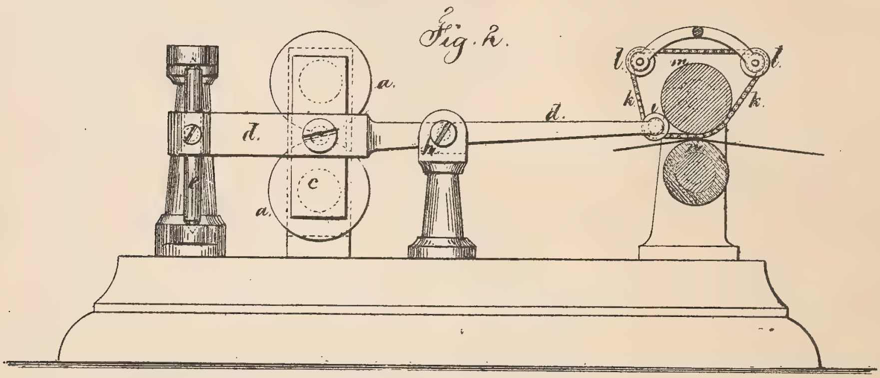
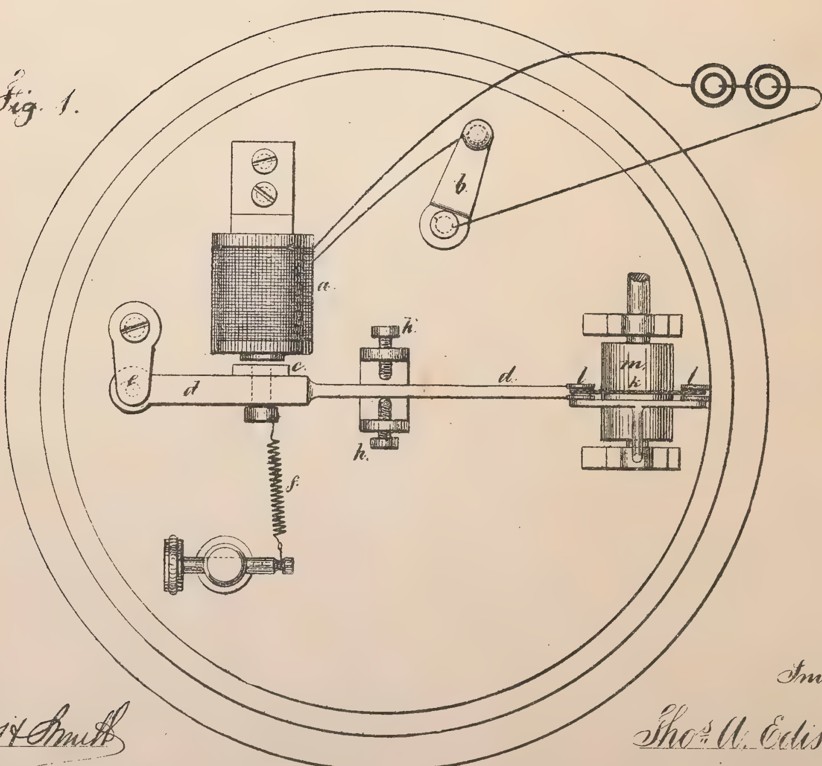


Fig. 1.



Witnesses

Chas H Smith

Harold Serrell

Inventor

Thos. A. Edison.

Lemuel W. Serrell

atty.

128,131

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,131, dated June 18, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Magnetic Telegraphs, and the following is declared to be a correct description of the same.

The ordinary magnetic telegraph is provided with a lever and point, the latter being held in contact with the paper to make a mark therein. In this case the magnetic energy must be sufficiently powerful to give the required pressure of the point on the paper.

My invention is made for giving a record by embossing the paper in a waving or zigzag line, by pressure between a rigid and an elastic roller, by means of a cord or chain that is positioned by the action of an electro-magnet. When the magnet is not charged the cord or chain will give a straight embossed mark; when the magnet is energized by a short pulsation the cord or chain will be moved out and back to produce a short undulation or V-formed embossing; and when the pulsation is longer the undulation will be of greater length, thus indicating dots and dashes. A comparatively feeble current can be employed, and yet the embossing will be so bold that the communication might be read by the touch, or the strip of paper might be used in an automatic machine to actuate mechanism for printing or otherwise preparing the message for delivery, a device for this purpose being contemplated by me.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of the apparatus, the rollers being in section.

The electro-magnet *a* is of any usual character, and is energized by pulsations in an electric circuit. The finger-key *b* illustrates the means for opening and closing this circuit. The armature *c* swings with the lever *d* upon the fulcrum *e*, and is retracted by the spring *f*, or drawn back or repelled in any suitable manner. The amount of motion to the lever *d* is determined by the screw-stops *h*. At the end of the lever *d* is a small roller, *i*, or opening, through which passes the endless chain or cord *k*, that is suspended or guided by the rollers *l*, and passes through between the rollers *m* and *n*. These rollers *m* and *n* are revolved constantly, while the machine is in action, by any suitable mechanism, and the roller *n* should have an elastic covering, and the paper pass in between said roller *n* and the chain or cord *k*. As the rollers *m n* revolve and draw the paper along, the chain *k* will emboss or indent the paper in a straight line; but when the magnet *a* attracts the armature the chain will be drawn off and produce a zigzag line, as shown in Fig. 3, the long undulations representing dashes and the short ones dots, as indicated by the corresponding line of telegraphic characters.

I claim as my invention—

A chain or cord under control of an electro-magnet, and pressed into contact with the surface of the paper to produce a telegraphic character by embossing, substantially as set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,604. Patented July 2, 1872.

Fig. 2.

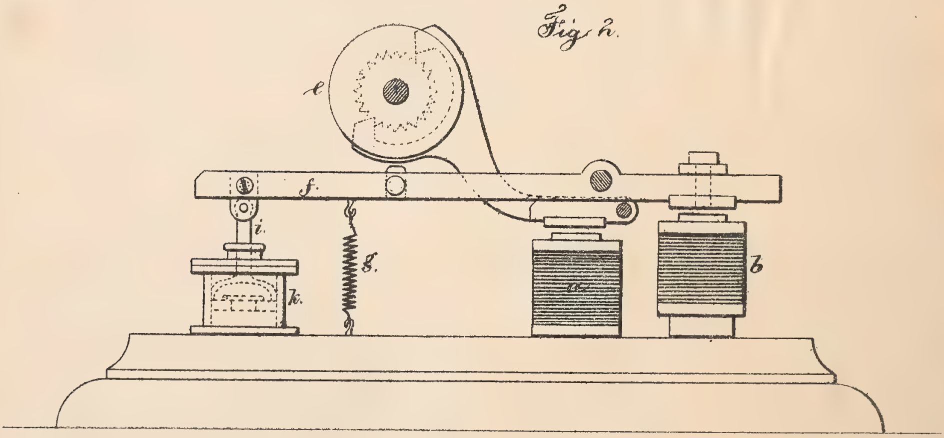
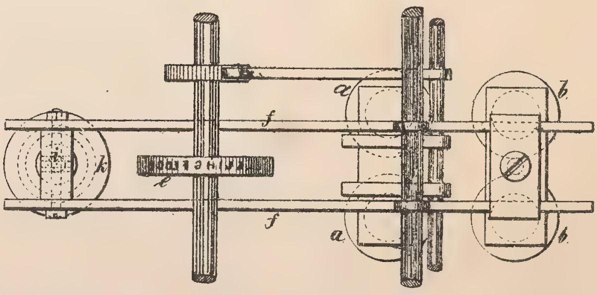


Fig. 1.



Witnesses.

Chas H. Smith

Harold Serrell

Inventor

Thos. A. Edison

Lemuel W. Serrell.

Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,604, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This invention relates to combining with the printing-lever an air-cushion that acts as a detainer to the printing mechanism so as to prevent it operating, except after the type-wheel has been set by the pulsations in the main line, and the circuit is kept closed while the air-cushion is sufficiently displaced to permit the impression.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of this improvement.

The type-wheel magnet *a* and printing magnet *b* are in the same electric circuit. The pulsations in the magnet *a* operate to set the type-wheel *e* by a step-by-step movement, but they do not move the impression-lever *f* sufficiently for printing, because the spring *g* is acting upon the same, and the air-cushion in the cylinder *k* formed between the piston and said cylinder arrests any sudden movement, and the spring *g* acts between the pulsations to keep the piston from gradually forcing the air out of the cylinder *k;* but when the circuit is kept closed at the transmitting station the printing-lever *f* is allowed to move and give the impression as the rod *i* moves the piston and displaces the air-cushion sufficiently to allow of this movement. The piston may have a valve to open as the lever descends, so as to allow the printing-pad to move rapidly away from the type-wheel.

I claim as my invention—

The air-cushion applied to and combined with the printing-lever and its magnet in a printing-telegraph instrument, in the manner and for the purposes specified.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,605. Patented July 2, 1872.

Fig. 2.

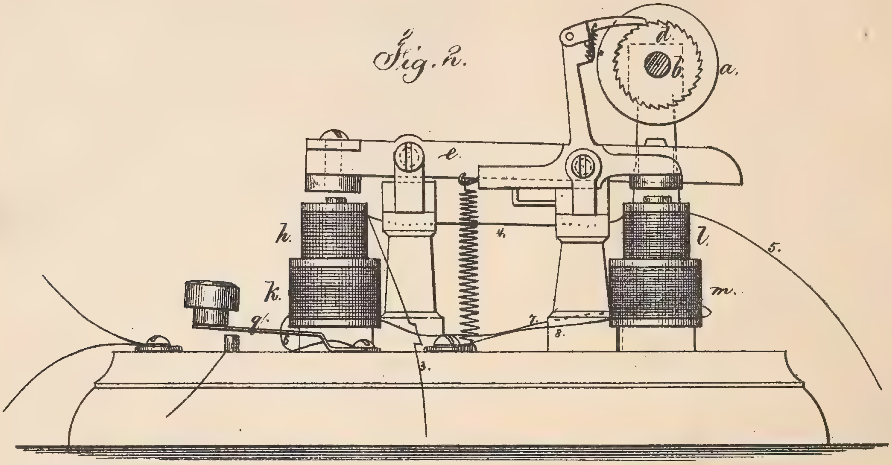
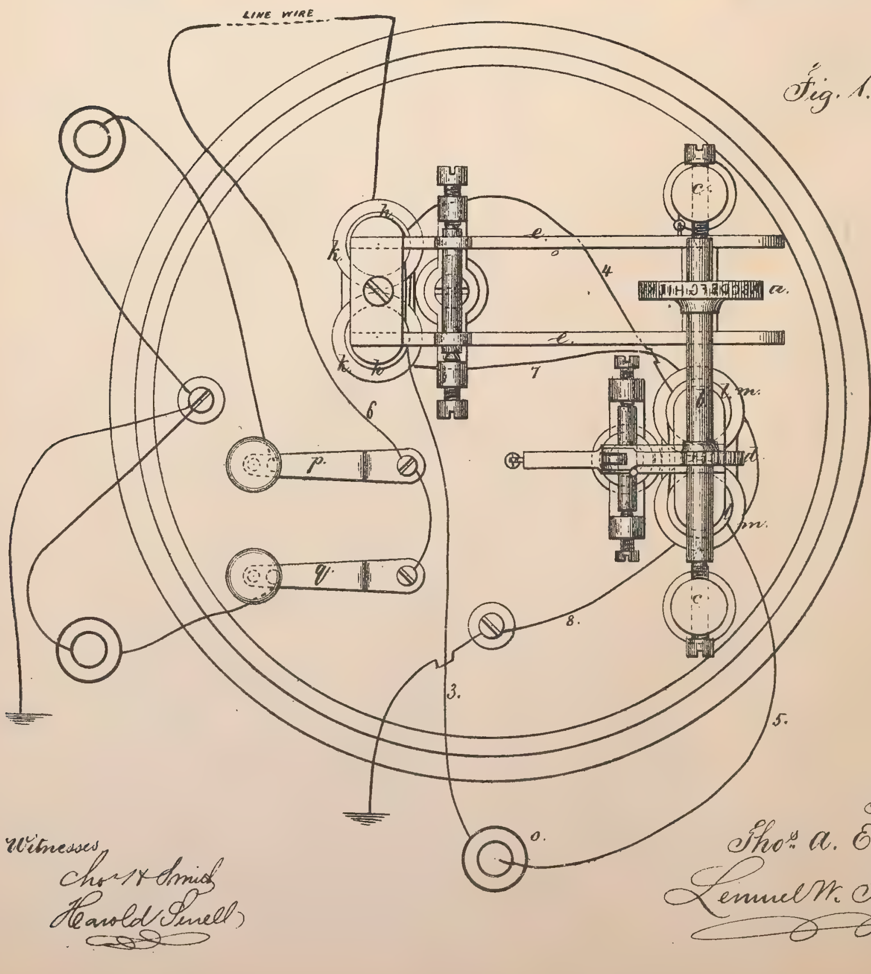


Fig. 1.



Witnesses
Chas H Smith
Harold Serrell

Inventor
Thos. A. Edison,
Lemuel W. Serrell att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,605, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is a correct description thereof.

This instrument is provided with two compound magnets—one to move the type-wheel, the other to move the printing-lever. One spool of each magnet is in a local constant circuit, and the other spools or helices are in the main line, and these are wound so that a positive current on the main line neutralizes the magnetism from the local constant battery in the printing-magnet and intensifies the magnetism in the type-wheel magnet; hence the type-wheel can be set by a current of one polarity, and, when the polarity of the main-line current is reversed, the magnetism in the type-wheel magnet is neutralized, and that in the printing-magnet intensified to give the impression.

In the drawing, Figure 1 is a plan of the instrument, and Fig. 2 is a side view with one of the standards or frame removed.

The type-wheel *a* on the shaft *b*, supported in the frames or standards *c*, is to be revolved by a step-by-step motion applied to the ratchet-wheel *d*, and the impression is given by the printing-lever *e;* and I remark that these parts may be of any desired character, as my invention may be employed with single or compound type-wheels and with any desired step-by-step movement. The printing-magnet is composed of the usual cores within the double spools or helices *h k*, and the type-wheel magnet is also compound, having the helices *l m*. The helices *h* and *l* are in a local constant circuit, 3 4 5, from the battery *o*, and the helices *k m* are in the circuit 6 7 8 connected to the main line. The keys or pulsators *p* and *q* may be of any desired character, such as a transmitting-dial, or other means for making and breaking the main-line circuit.

The parts are arranged and the helices wound so that when a current of one polarity is sent over the main line the printing-magnet will be inoperative, in consequence of the current in the helices *k* tending to produce polarity in the cores the reverse of that produced by the constant circuit in the spools *h*. At the same time the type-wheel magnet will be sufficiently energized to overcome its resistance or spring, in consequence of the current in both helices *l m* producing the same polarity in the cores; but when a pulsation of the opposite polarity is sent the type-wheel magnet will be inoperative, and the printing-magnet energized to give the impression.

In this manner a printing-telegraph instrument can be operated by one line-wire without any switch or polarized circuit-changer, the local constant battery being employed with each instrument.

I claim as my invention—

The compound type-wheel magnet and the compound printing-magnet in a printing-telegraph instrument, in combination with a local constant circuit connected to one set of spools in such magnets, and the main-line current connected to the other spools of such magnets, to be operated substantially in the manner and for the purposes set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 128,606. Patented July 2, 1872.

Fig. 2.

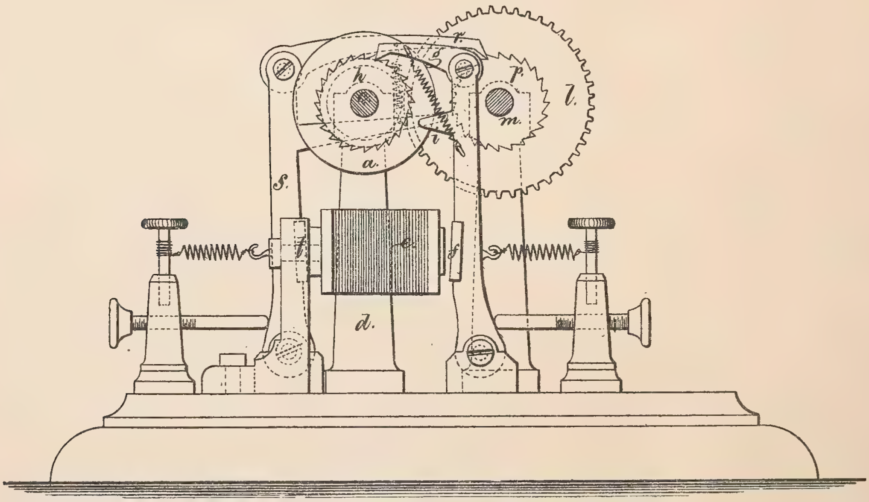
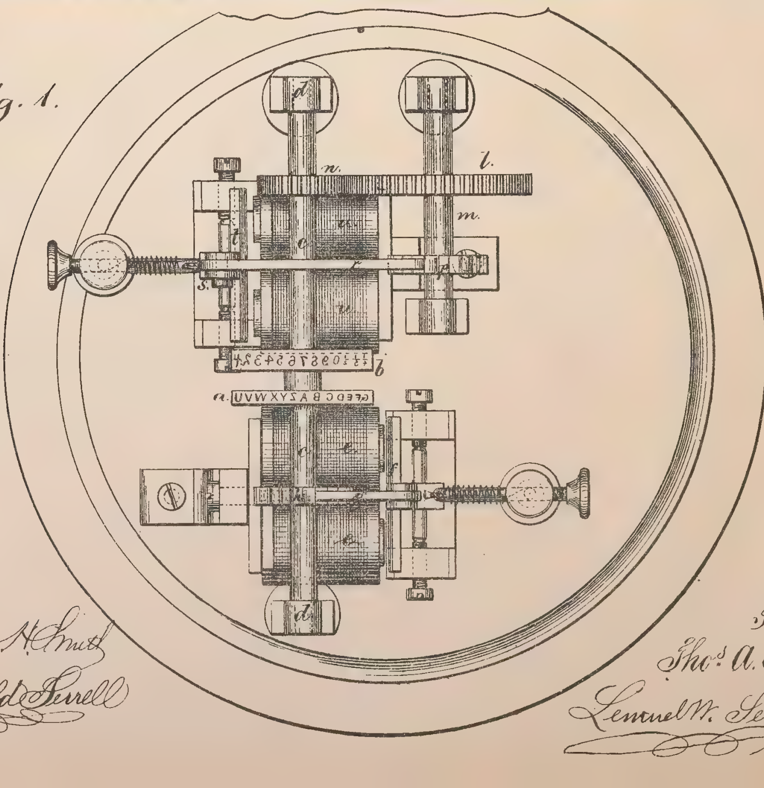


Fig. 1.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thos. A. Edison

Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,606, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

In printing-telegraphs considerable time is lost in actuating the step-by-step movement, because there is no opportunity to move the type-wheel more than one letter at a time.

My invention is made to promote rapidity in actuating the type-wheel. Said invention consists in a multiplied motion from a step-by-step movement applied to the type-wheel, so that one pulsation on the line will give a motion to the type-wheel equal to two or more letters. The parts are constructed and arranged so that either the multiplied movement can be given, or the single step-by-step motion, according to the letter to be brought into position for printing.

In the drawing, Figure 1 is a plan of my instrument, and Fig. 2 is an elevation of the same.

The type-wheel *a* and figure-wheel *b* are shown as upon the shaft *c*, sustained in suitable frames or bearings *d*, and I remark that these type-wheels may be of any desired character, and either single or double, and the impression mechanism may be of any available character. The magnet *e*, armature *f*, pawl *g*, ratchet *h*, and stop *i* are of any ordinary or desired character, and act to move the type-wheel around one letter at a time by a step-by-step movement. The gear-wheel *l*, upon the shaft *m*, takes into the pinion *n* upon the type-wheel shaft *c*, and these two gears are proportioned so that the wheel *l* contains, say, six times the number of teeth in the pinion; thereby the type-wheel will be revolved six times for one revolution of the shaft *m*. Upon this shaft *m* is a ratchet-wheel, *p*, operated by the pawl *r*, lever *s*, armature *t*, and magnet *u*. If the ratchet-wheels *h* and *p* have the same number of teeth, and the proportion of gearing aforesaid was used, then for each pulsation in the magnet *u* the type-wheel will move six letters or spaces, and complete a revolution in either four or five pulsations of the magnet *u*, according to the number of characters upon such type-wheels. In this manner great rapidity can be obtained, because the long intervals and numerous pulsations required between impressing one letter and the next are lessened. The magnet *u* may be energized by a reversal of the current operating in the magnet *e*, or by a separate line-wire. The transmitting dial or instrument may be of any desired character adapted to these two magnets, and the currents to them.

I claim as my invention—

A type-wheel in combination with two actuating magnets and connections, substantially as set forth, one for operating a step-by-step motion one letter or division at a time, and the other for moving the type-wheel two or more letters or divisions at a time, substantially as specified.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON. *Case No. 34.*

Improvement in Printing-Telegraphs.

No. 128,607. Patented July 2, 1872.

Fig. 2.

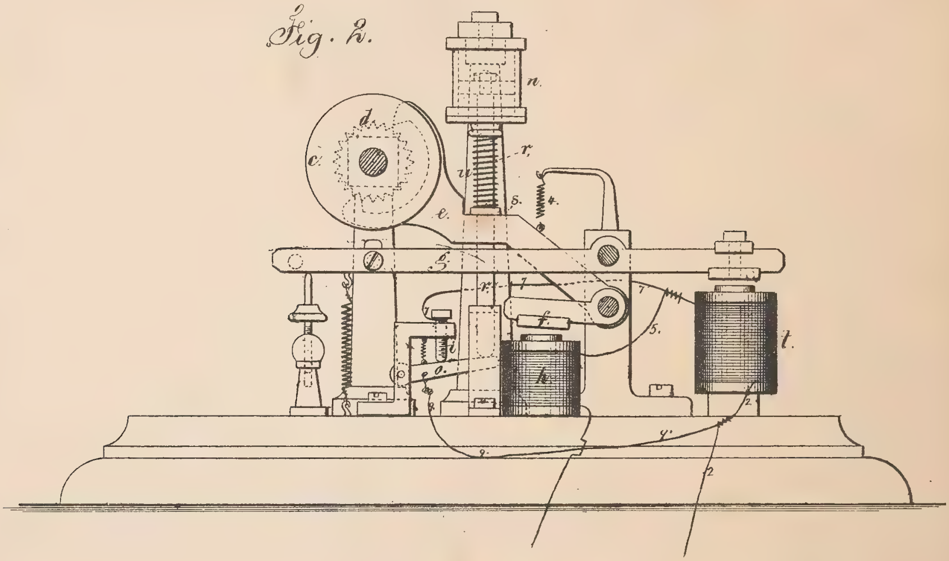
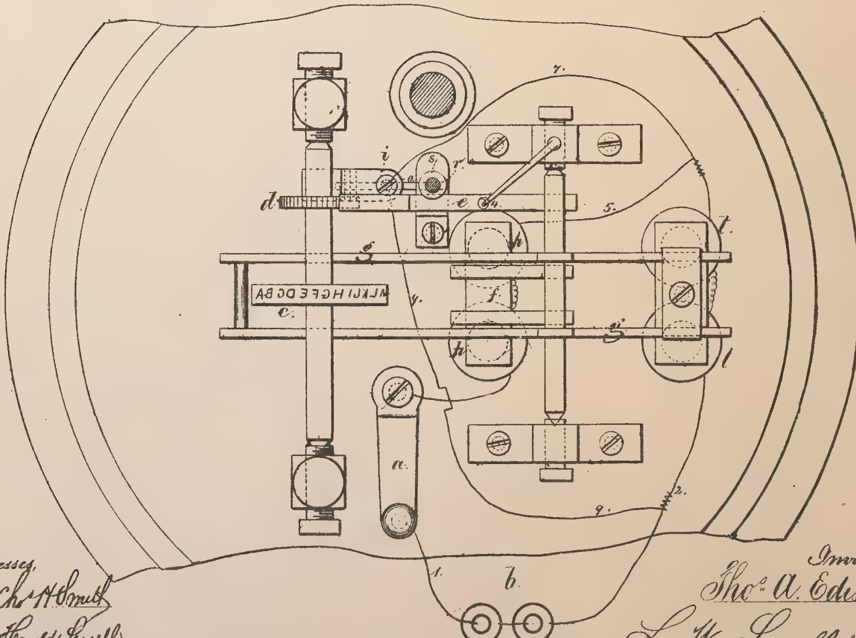


Fig. 1.



Witnesses,
Chas H. Smith
Harold Serrell

Inventor
Thos. A. Edison
L. W. Serrell
atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 128,607, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In this instrument the magnet that gives the impression is in the main-line circuit as well as the type-wheel magnet, but the former is "cut out" by a shunt or short circuit that is closed when the instrument is not working, and during the pulsations that set the type-wheel; but when a pause occurs with the circuit closed this short circuit is broken by a gradually-operating spring or weight controlled by an air-cushion, so that the electricity is forced to pass through the printing-magnet and gives the impression, simply in consequence of keeping the circuit closed when the letter to be printed has arrived in position for the impression.

In the drawing, Figure 1 is a plan, and Fig. 2 an elevation, of the instrument.

The finger-key *a* is introduced to illustrate any suitable apparatus for opening and closing the electric circuit from the battery *b*. 1 represents the line-wire, and 2 the ground or return circuit. The type-wheel *c* is moved by any suitable step-by-step motion. I have shown the ratchet-wheel *d* and lever *e*, operated by the armature *f* and spring 4. The printing-lever *g* may also be of any desired character. The type-wheel magnet *h* is connected with the line-wire 1, and from this the wire 5 leads to the printing-magnet *t*, and thence the circuit returns by the wire 2. If this alone was used, both magnets would be energized each pulsation; therefore, to prevent this, I employ the short circuit or shunt, composed of the wire 7 leading to the screw *i*, and the wire 9 leading to the tongue *o*. The air-cushion is made of the cylinder *n*, within which is a piston, and the rod *r* of the same rests at its lower end upon the tongue *o*, and the parts are adjusted so that the circuit between *i* and *o* is closed when the parts are at rest, because a collar, *s*, on the rod *r* rests upon the type-wheel lever *e* and holds the rod *r* up against the spring *u*. When the type-wheel lever *g* is vibrated in setting the type-wheel, the movement is sufficiently rapid to keep pressing the rod *r* up against the action of the spring *u*, and the air-cushion prevents its return with rapidity; but when a pause takes place in the pulsations, and the circuit is kept closed, the rod *r* descends and moves the tongue *o*, breaking the shunt-circuit through 7, *i*, *o*, and 9, and compelling the electricity to pass through the magnet *t* and produce the printing. The parts return to the position of inactivity with magnet *t* cut out by the circuit 7 *i o* 9, when the circuit is broken at the transmitting station, and I remark that there might be a finger upon the printing-lever *g* to lift the rod *r*, in which case the impression-lever would drop back instantly, as the circuit would be closed again through 7, *i*, *o*, and 9; and in this manner a second or third impression of the same letter, number, or character would be given by keeping the circuit closed at the transmitting station to allow sufficient time for the rod *r* to descend again and open the shunt at *o i*.

I claim as my invention—

Two electro-magnets, one for operating the type-wheel lever, the other for giving the impression, both in the main circuit, in combination with a "shunt" or "cut-out" circuit and a shunt-breaker, substantially as and for the purposes set forth.

Signed by me this 26th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing-Telegraph Instruments.

No. 128,608. Patented July 2, 1872.

Fig. 3.

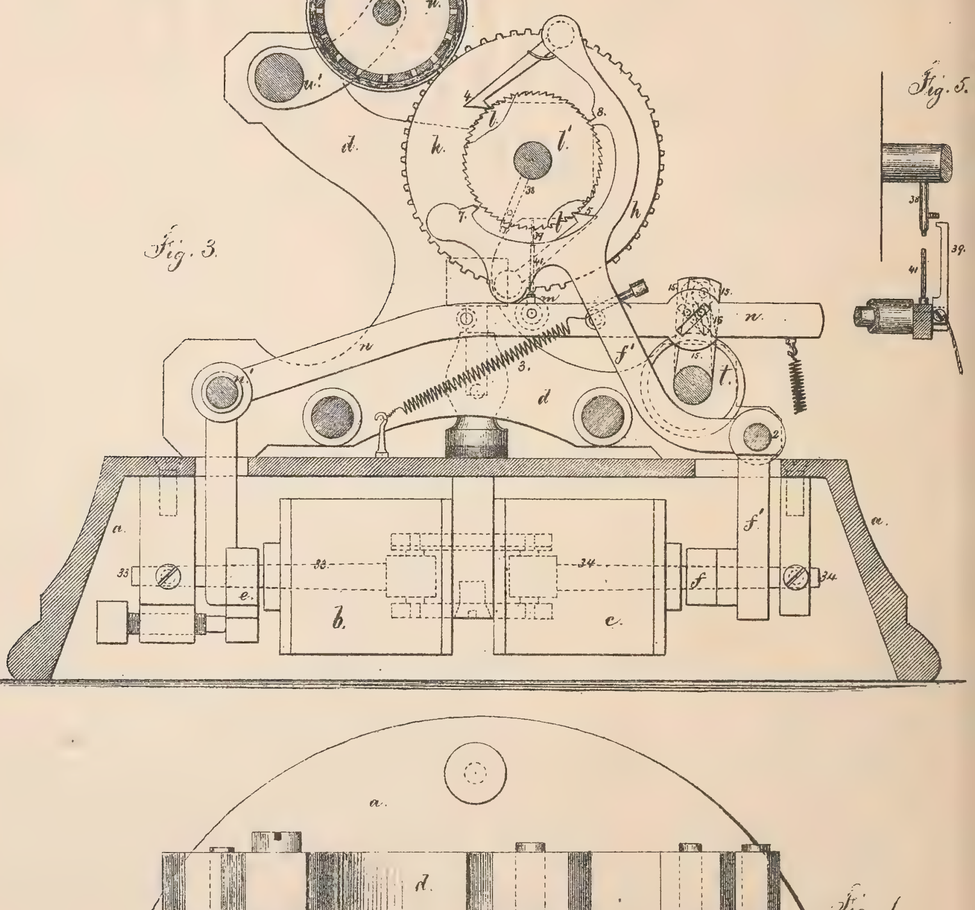
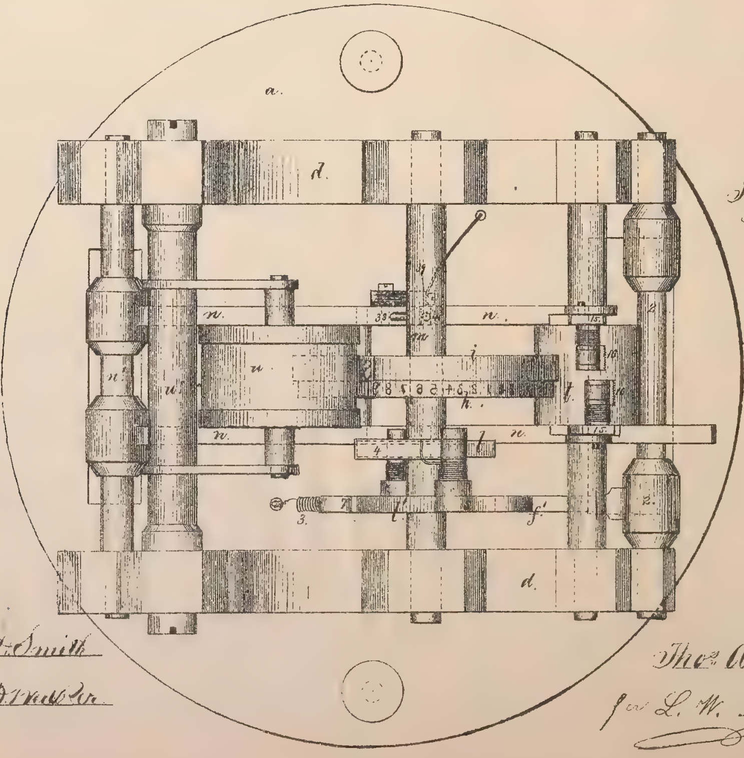


Fig. 5.

Fig. 1.



Witnesses.

Chas. F. Smith

Geo. D. Walker

Thos. A. Edison,

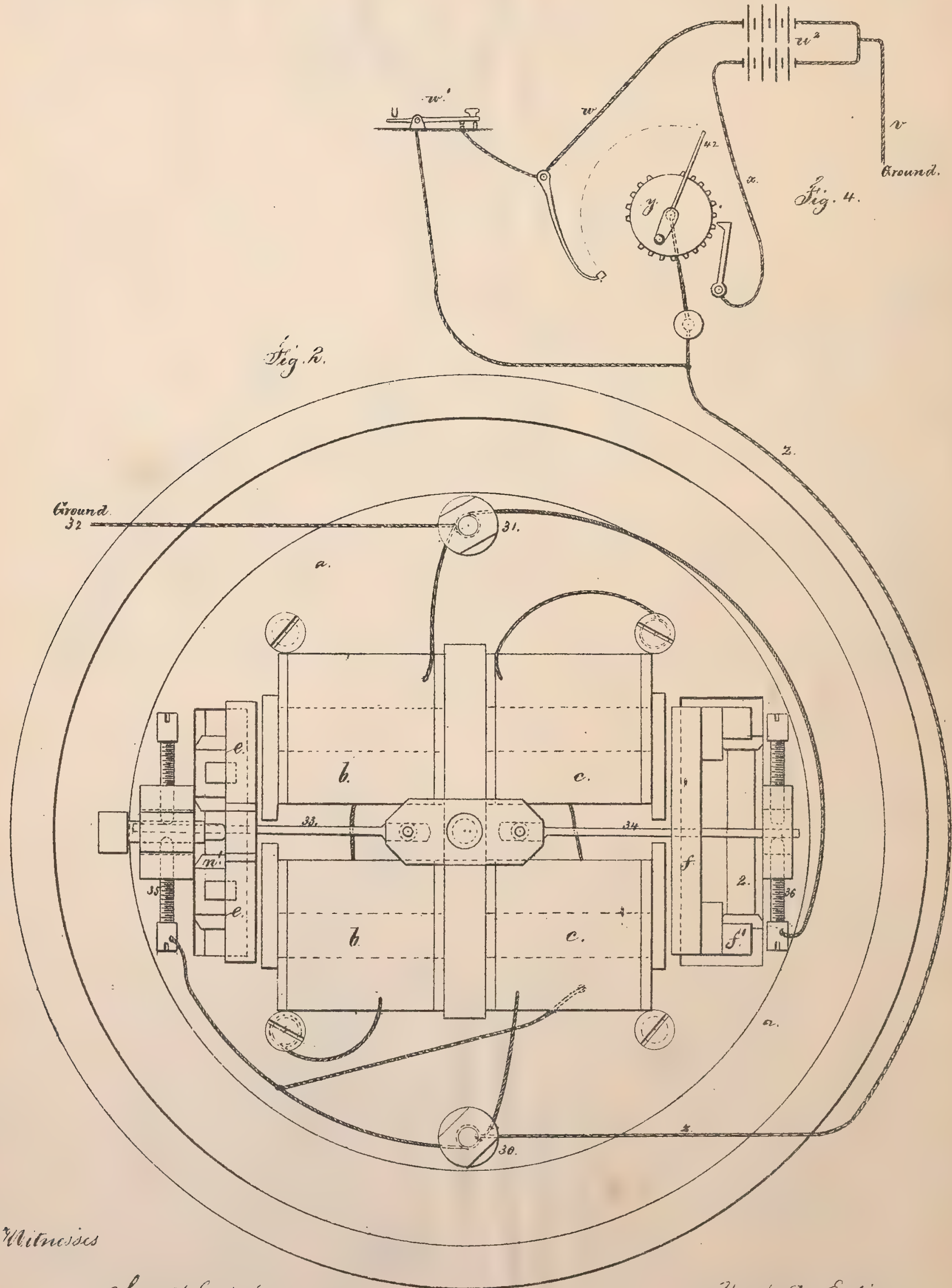
per L. W. Serrell

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Printing-Telegraph Instruments.

No. 128,608. Patented July 2, 1872.



Witnesses

Chas H. Smith

Geo. D. Walker.

Thos A. Edison

per L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. 128,608, dated July 2, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made a new and useful Improvement in Printing-Telegraphs, and the following is declared to be a correct description thereof.

Printing-telegraphs have been constructed to work upon a single wire by means of two electro-magnets and one polarized magnet, so combined with each other that a current of one polarity is made to act upon one electro-magnet and an opposite current upon the other magnet by arranging cut-offs upon the electro-magnets and rendering them active or inactive, as the case may be, by the polarized magnet. My present invention consists of a compound electro-magnet, constructed in such a manner that when a current of one polarity enters both parts of the magnet the polarity of the current acting upon the devices of the compound magnet determine which part shall become active or magnetic, thereby dispensing with a third magnet. In this manner two operations, distinct from each other, can be performed with the use of only one line-wire. I also provide a unison connection, so that the act of transmitting pulsations from the sending station can be availed of to set all the type-wheels of the several instruments placed in one electrical circuit at a zero-point at each complete revolution of the type-wheel, thereby insuring accuracy in transmission in consequence of the frequent unison action.

In the drawing, Fig. 1 is a plan. Fig. 2 is an inverted plan. Fig. 3 is a vertical section, and Fig. 4 is a diagram illustrative of the connections.

The base *a* contains within it the compound magnet *b c*, and upon said base are the frames *d*, carrying the respective shafts and axes. The part *b* of the compound magnet acts upon the armature *e* of the printing and paper-feeding mechanism, and the portion *c* acts upon the armature *f* and lever *f'* to operate the type wheel. The type-wheel is made of two rings upon arms, the one ring *h* having figures, signs, or fractions, and the other ring, *i*, has letters or similar characters, so that either one or the other can be printed at will, because the characters on one wheel come opposite a blank space on the other wheel, as illustrated in the drawing, in which the figures and fractions come between the terminal letters of the alphabet, facilitating the construction and setting of the wheel, and allowing the letters to be printed on one line and the figures and fractions on another, and there is a portion of the type-wheel where there are not any characters, and at this part the unison connection is made to operate. The lever *f'* is on a fulcrum, 2, and the spring 3 acts to draw the armature from the magnet when the electrical circuit is broken. The lever *f'* has arms carrying the spring-pawls 4 and 5, that have hooked ends acting upon the wheel *l* so as to move the said wheel *l* one tooth at each vibration of the lever *f'*, the pawl 4, upon the return movement of the armature, giving a partial movement to the type-wheel so as to insure the catching of the pawl 5 over the next foot and lessen the amount of play of the escapement-lever. The lever *f'* has stop-spurs, 7 and 8, acting with the reverse ratchet-teeth of the wheel *l'* to check the movement and prevent the momentum carrying the type-wheel more than one letter at a time. The stop-spurs 7 and 8 are arranged so that the holding-faces are at right angles to lines drawn from the center of motion 2, so that the locking will be of the most reliable character, there being no tendency to move the spurs by the concussion of the wheel against them in stopping.

The printing or impression is effected by the pad *m* upon the lever *n*, that is mounted upon the axis or fulcrum *n'* and actuated by the armature *e* to the magnet *b*. The paper is fed along by the movement of the impression-lever. The roller *t* is mounted upon an axis that has upon each side of the roller sleeves that carry crank-arms 15 and spring-pawls or points 16, and in the ends of the two portions of the lever *n* that pass contiguous to these arms 15 are diagonal slots placed in opposite positions and taking pins that project from the arms 15, so that as the lever *n* rises one pawl, 16, will

bind the paper to the roller t and carry both forward, and the other pawl will be drawn back, so that as the lever n descends the first-named pawl 16 is drawn back and the other pawl made to operate in feeding the paper. Thus the paper can be moved along with facility, as there are two movements to each impression of the letter or type; consequently but one-half the motion of the lever is required as would be the case if only one feed-pawl was used. The ink is supplied to the types by means of a hollow perforated drum, u, or roller, into which the ink is introduced, and around this roller a cloth or felt surface is attached, as seen in Fig. 3, to rest upon the types of the type-wheel. The ink gradually passes through the perforations and the surrounding cloth, and thus the quantity necessary for the types is furnished. The roller u is upon arms swinging upon the shaft u^1, so that the ink-roller lies constantly in contact with the type-wheel. The connections for the compound magnet are illustrated in the plan, Fig. 2; and diagram, Fig. 3. The battery at u^2 is divided, a connection, v, passing from near the center to the ground. The wire w passes to the finger-key w', and from the other end of the battery the wire x passes to the transmitting instrument y; thence to the line-wire z, uniting with a wire from the finger-key and passing to the binding-screw 30 of the instrument. The wire z passes from the binding-screw 31 of one instrument to the screw 30 of the next, and so on through as many instruments as there are in the line, and then connecting to the ground at 32, beyond the last instrument. Between the helices b b and c c of the compound magnet are steel tongues 33 34, hinged at one end and swinging freely horizontally. The polarity of b and c will, with a positive current, attract by means of the arms at the ends of the soft-iron magnet the tongue 34 to the circuit-closer 36, and repelling the tongue 33 from 35. By changing the currents the reverse movements take place of the tongue. The transmitting-dial y is made in any usual manner, so as to give the pulsations through the wire z and screw 30, and the current being positive the compound magnet as charged connects 34 and 36 and breaks 33 and 35 by the reversed polarity; hence the current will be directed through the helices c, the base-plate forming a part of the circuit, to operate the type-wheel by the armature f and lever f'. The current passes from the helix c to the bed a of the instrument; thence through the tongue 34, (which is in metallic contact with the base,) circuit-closer 36, to the screw 31 of the line or ground wire, returning by 32 and v. If the finger-key w' is closed when the circuit through y is broken the direction of current is instantly changed and the compound magnet b c is altered in its polarity, 34 and 36 separating and 33 and 35 closing, so that the magnet b is made fully operative to effect the printing; the current passing from 31 to the magnet b, thence to the base a, switch 33, closer 35, binding-screw 30, to the key w', and battery, and vice versa.

In order to insure unison of movement in the type-wheels of several machines in one line or circuit, I provide two or more blank spaces on each type-wheel, and employ an arm, 38, on the type-wheel shaft, which, when a given one of these blank spaces is opposite the impression-pad, comes in contact with the insulated circuit-closing spring 39, so that a direct current passes through this spring, the type-wheel shaft, and the bed of the machine instead of the magnet c; hence the magnet ceases to be operative, although the current proceeds to other machines and operates upon the same, bringing them to the same position should they not be in that position. Upon reversing the current through w' the impression-magnet b operates the lever n, lifts the spring from contact with the arm 38, breaking the current through 39, and simultaneously the stud 41, coming against the end of the arm 38, prevents the movement of the lever n sufficiently to impress or feed the paper; the spring 39, being slightly under strain by the arm 38, clears the same, as the parts resume their normal position. These parts are shown more clearly in Fig. 5.

By having an arm upon the transmitting instrument, as shown at 42, and locating the same so as to close the circuit between w and z, at the period in the rotation of the dial when the machines are to be brought to a normal position, the machinery becomes self-operating without the use of the finger-key, and applies a correcting movement to all the type-wheels in the electrical circuit every rotation of the type-wheel, hence insuring great accuracy.

I do not claim a hollow perforated inking-drum, as the same is shown in the patent of S. S. Laws, No. 99,273.

I claim as my invention—

1. A compound magnet provided with steel tongues that direct the force of the electrical current through one portion of the magnet or through another portion, according to the direction in which the current passes to said compound magnet, substantially as specified.

2. The double-acting pawls 4 5, stops 7 8, and lever f', combined with the ratchet and type-wheel, as set forth.

3. Two type-wheels on one shaft parallel to each other, and arranged so that the blank spaces upon one wheel come opposite to the characters on the other, and vice versa, substantially as set forth.

4. The hollow perforated inking-drum surrounded with a surface of fibrous material, and arranged so that the said surface is in contact with the type-wheel, as and for the purposes specified.

5. The pawls 16 16, and crank-arms actuated by the lever *n* to feed the paper, in the manner specified.

6. The arrangement of the magnets that operate the type-wheel and printing mechanism within the bed of the machine, as set forth.

7. The circuit-closing spring 39 and arm 38, arranged, substantially as set forth, to stop the action of the magnet *b*, for the purpose of bringing several machines in one main circuit into unison, substantially as set forth.

8. The combination of the compound magnet, the type-wheel, and actuating mechanism with the printing and paper-feeding mechanism, substantially as set forth.

Signed this 24th day of May, A. D. 1870.

THOMAS A. EDISON.

Witnesses:

HAROLD SERRELL,

GEO. T. PINCKNEY.

T. A. EDISON.

Improvement in Electro-Magnets.

No. 130,795. Patented Aug. 27, 1872.

Fig. 2.

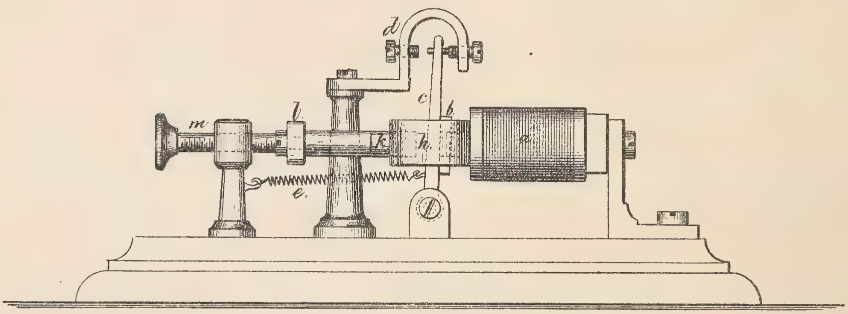
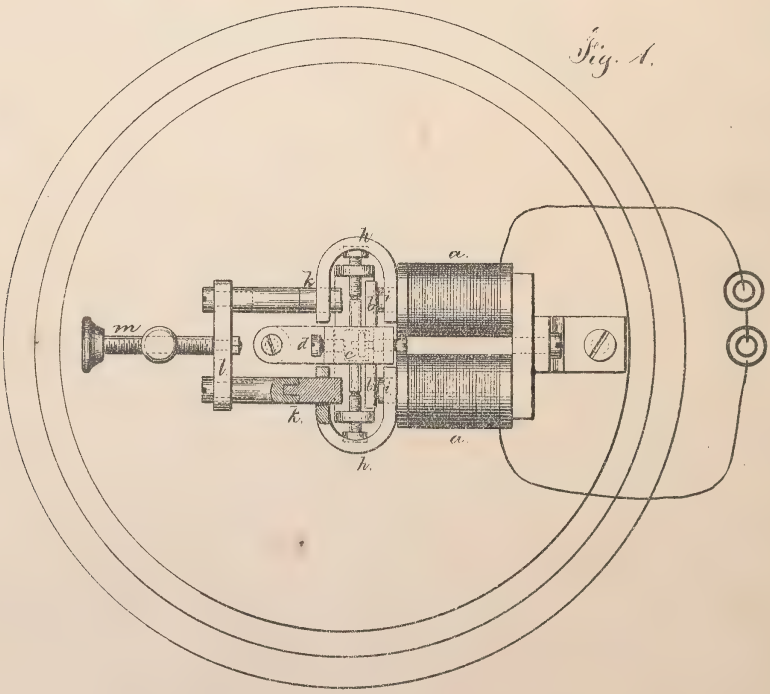


Fig. 1.



INVENTOR

Chas H Smith

Thomas A. Edison,

Witnesses.

Per L. W. Serrell

Geo. D. Walker

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN ELECTRO-MAGNETS.

Specification forming part of Letters Patent No. **130,795**, dated August 27, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electro-Magnets; and the following is declared to be a correct description of the same.

If two magnets of equal power act in opposite directions and at the same distance from a swinging armature, said armature will not be moved; but by removing one magnet further from the armature the other will be free to exert on that armature a force equal to the difference between the effective force of one magnet and the other. I avail of the foregoing features, and, instead of employing an adjustable spring to draw the armature back, I use a weight or spring of uniform power, and I provide a balancing-pole energized by induced magnetism from the core of the electro-magnet, and use an adjustment, so that the power of the electro-magnet and the induced magnet are balanced in their action on the armature; thus, when the electro-magnet is energized by a powerful current the induced magnetic pole will act with a proportionate power in the opposite direction, or may be adjusted so as to leave only sufficient surplus of force in the electro-magnet to overcome the spring or weight; hence the armature will respond very rapidly, because the opposing forces neutralize each other instantly upon the circuit through the electro-magnet being broken.

In the drawing, Figure 1 is a plan, and Fig. 2 is a side view, of this improvement as applied to a relay-magnet.

The electro-magnet *a* is of usual character. The armature *b* is shown as on the swinging lever *c* that opens and closes the local circuit at *d*, and a spring or weight at *e* acts to draw back the armature. These parts are to be of any usual or desired character, according to the work for which the instrument is to be employed. The iron yokes *h* are connected with the cores *i i* of the electro-magnets, and they extend around to the balancing-poles *k k* that pass through these yokes, and are made of iron, and hence are magnetized with the same polarity as the cores *i i* by induction. These poles *k* are to be adjusted to stand at the proper distance from the back of the armature, and for this purpose any suitable means may be employed—such as the cross-bar *l* and screw *m*—which must not be of iron, or the proper polarity of the poles *k* would be interfered with.

It will be apparent that the attraction of the poles *k* is acting up the armature *b* in the opposite direction to that of the cores *i*, hence that the relative distance of the poles from the armature must be such that the proper force will be exerted to move the armature when the electro-magnet is energized. If the current is powerful the poles *k* should be closer to the armature, and if feeble the poles should be further removed.

I claim as my invention—

The balancing-poles *k*, energized by induced magnetism from the cores *i* of the electro-magnet, and acting in opposite direction to such electro magnet, substantially as set forth.

Signed by me this 9th day of May, 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Rheotomes or Circuit-Directors.

No. 131,334. Patented Sep. 17, 1872.

Fig. 2.

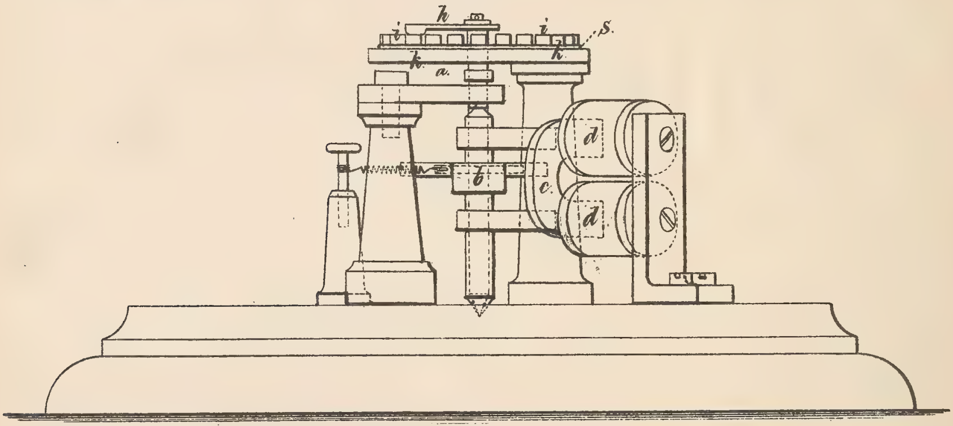
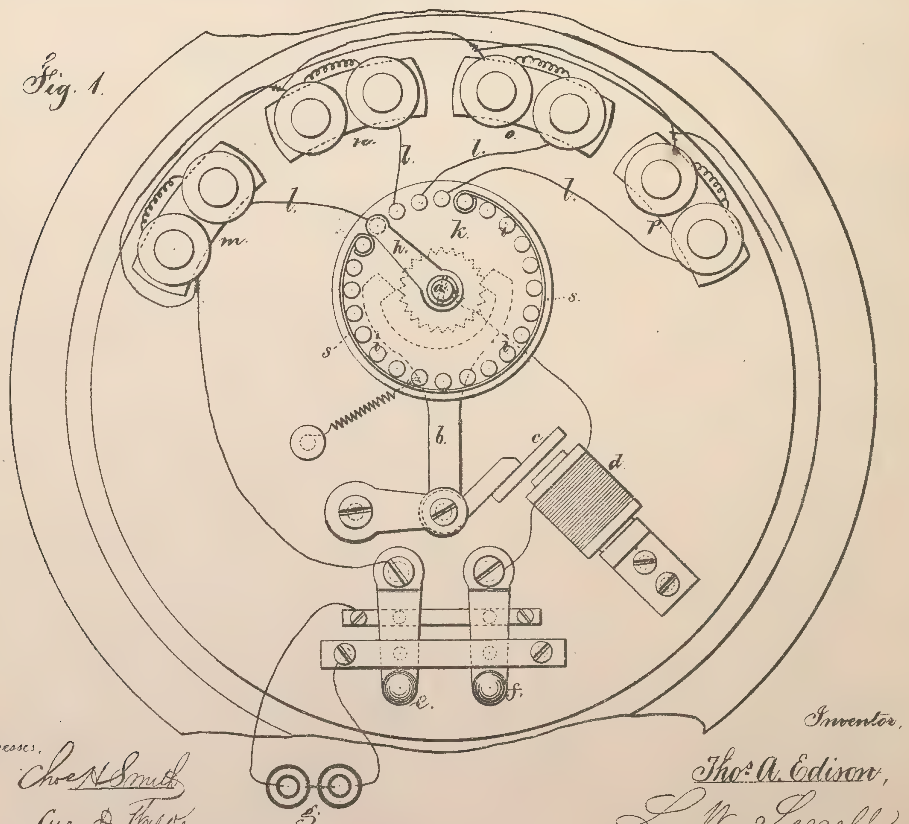


Fig. 1.



Witnesses,

Chas H Smith

Geo. D. Walker

Inventor,

Thos. A. Edison,

L. W. Serrell

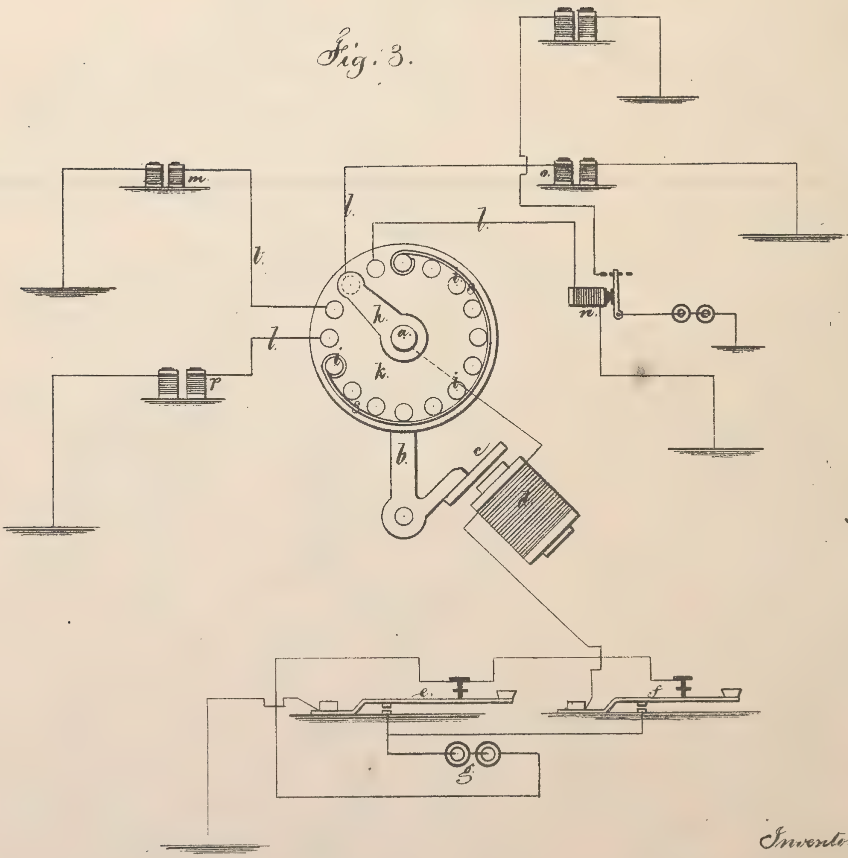
atty.

T. A. EDISON.

Improvement in Rheotomes or Circuit-Directors.

No. 131,334. Patented Sep. 17, 1872.

Fig: 3.



Witnesses,

Chs H Smith

Geo. D. Walker.

Inventor

Thos A. Edison,

L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN RHEOTOMES OR CIRCUIT-DIRECTORS.

Specification forming part of Letters Patent No. **131,334,** dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improved Rheotome or Circuit-Director; and the following is declared to be a correct description of the same.

This invention is for selecting from a number of telegraphic circuits the particular one to which a message is to be communicated. For instance, a connection from the sending-station, say at New York, may pass to this improved instrument located, say at Philadelphia, and by operating said instrument at Philadelphia by a negative current, a connection may be opened with a line to Reading, Harrisburg, Baltimore, or any other desired point, and communication be made direct or through a relay by pulsations of positive polarity, the rheotome instrument at Philadelphia remaining passive until again operated by a current of the opposite polarity.

I make use of a circuit-closing arm revolved in contact with the circular range of insulated circuit-closing pins by a step-by-step movement actuated by an electro-magnet upon an armature that is polarized, and the circuit is closed through one of said pins to the distant station, or to a relay-magnet to the distant station, and the step-by-step movement is actuated by pulsations of one polarity; but if the opposite polarity is employed there will not be any movement of the rheotome, because the polarity of the electro-magnet is such as to repel the polarized armature.

In the drawing, Figure 1 is a plan of the machine adapted to relay-magnets in local lines. Fig. 2 is an elevation of the said rheotome, and Fig. 3 is a diagram illustrative of the connections.

The vertical shaft *a* is revolved by a step-by-step movement of any desired character. I have shown the lever *b* and a ratchet-wheel. This lever *b* carries a polarized armature, *c*, that is operated by the electro-magnet or magnets *d* in the main-line circuits, and *e* and *f* are finger-keys, by means of which pulsations of positive or negative polarity can be sent over the main line from the battery *g* to the magnet or magnets *d*. The shaft *a* is also in the main-line circuit and carries the selecting-arm *h*, the end of which moves around in contact with the pins or conductors *i* in the rheotome-plate *k*. The conductors *i* are connected to the wires *l*, that lead to either distant magnets by line-wires or to relay-magnets *m n o p*, that are constructed in any desired manner to operate local or relay circuits, or perform any other desired operation. The end of the arm *h* must be wide enough to reach from one of the conductors *i* to the next while being moved around, otherwise the circuit will be broken, and the hand remain stationary, and I remark that the rheotome is adapted to a large number of circuits; but may be used with only three or four, and a wire, *s*, is employed to connect all the conductor-pins *i* that are not otherwise connected to local or relay circuits, so that the selector-hand may be revolved all the way round in making any selection desired.

The operator energizes the magnet *d* with pulsations that will cause the polarized armature *c* to be attracted, say, of positive polarity, and the current passes from the battery *g* through *f*, *d*, *a*, *h*, *i*, and *l* through one of the electro-magnets *m*, *n*, *o*, or *p*, and by the ground back through *e* to *g*, and according to the number of pulsations, so the arm *h* will stop over one or the other of the pins *i* and make the connection through the same to its magnet. When the key *e* is operated and pulsations of opposite polarity sent, the arm *h* will not be moved because the polarized armature *c* will remain unacted upon. The electric pulsations passing on through *h i l* may act in an electro-magnet to affect any object at *m p o*, Fig. 3. These electro-magnets are shown as at a distant station. They might, however, all be near the rheotome, as illustrated at *n*, to operate relay or local circuits. The wire *s* insures a circuit connection through either of the pins *i* that is not connected to a local or relay circuit.

Instead of using a single magnet, *d*, there might be a double one, and the armature vibrate between the cores; in this instance a retractile spring to the armature is rendered unnecessary, and the rheotome will be set by alternate pulsations of opposite polarity, and

the rheotome will not be moved by a repetition of pulsations of one polarity, and these will act at the distant magnet.

I claim as my invention—

1. The rheotome, formed of the arm *h* and conductor-pins *i*, in combination with the magnet *d* and polarized armature, substantially as and for the purposes set forth.

2. The wire or conductor *s*, connecting the circuit-pins *i i* of the rheotome, in combination with the arm *h*, magnet *d*, and polarized armature, substantially as set forth.

Signed by me this 6th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,335. Patented Sep. 17, 1872.

Fig. 2.

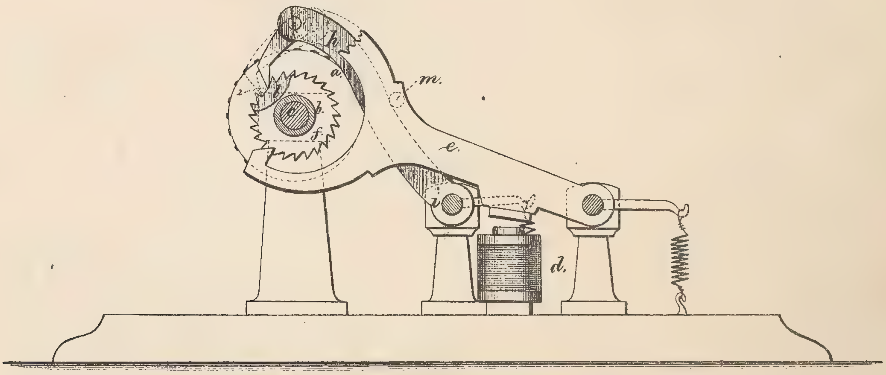
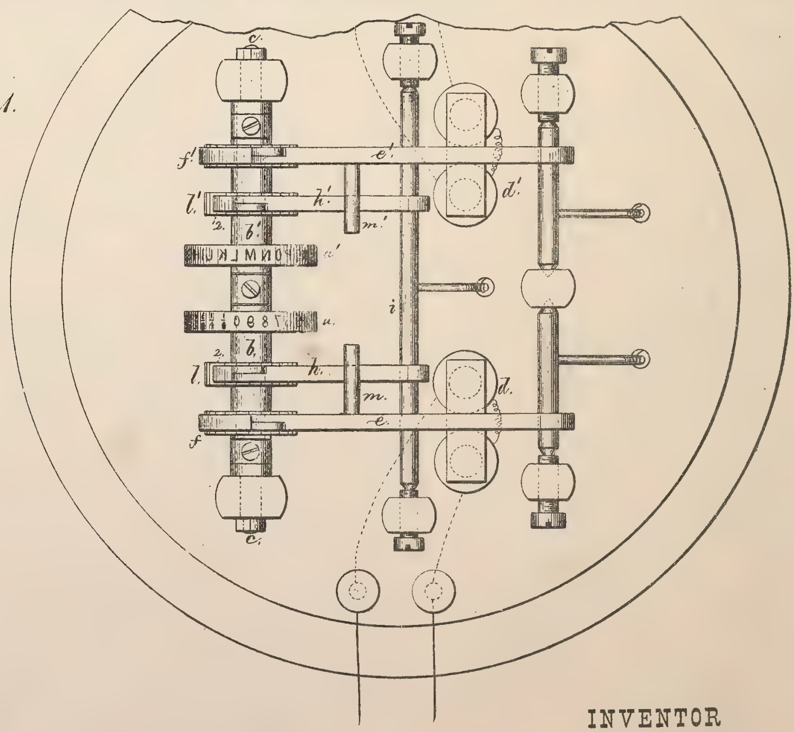


Fig. 1.



INVENTOR

Thomas A. Edison,

Per. Lemuel W. Serrell

ATTY

Chas H Smith

Harold Serrell

Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,335**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

This instrument is of that class in which two type-wheels, rotated by separate step-by-step movements, are employed to print in two lines upon one strip of paper. My improvement relates to employing an auxiliary lever and ratchet-wheel in connection with each of the usual type-wheel levers, and these auxiliary levers are so arranged that when either of the type-wheel levers is vibrated by its magnet to rotate the type-wheel the other type-wheel is rotated and brought to unison by means of the auxiliary lever acting upon its ratchet-wheel, and rotating said wheel until its pawl or pallet ceases to turn said wheel, in consequence of a tooth being removed from the same. The space where the tooth is removed from the ratchet-wheel is at a place in such relation to the zero or unison point of the type-wheel that when said ratchet-wheel stops revolving the type-wheel is at zero, and is in unison with the transmitter, and so remains ready to be brought into action by that instrument.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is a sectional elevation of the same.

a a′ are the type-wheels secured to the sleeves *b b′*, which revolve upon the stationary shaft *c*, when actuated by their respective electro-magnets *d d′*, through the armatures and levers *e e′* and ratchet-wheels *f f′*. The magnets *d d′* are in independent electric circuits, and either type-wheel may be revolved, stopped, and printed from, according to which magnet is energized, as heretofore usual. *h h′* are the auxiliary levers upon the shaft or fulcrum *i*, and *l l′* are their respective ratchet-wheels secured to the sleeves *b b′;* and from each wheel *l l′* a tooth is removed, as at 2. These levers *h h′* are contiguous to the levers *e e′*, and pins *m m′* project from the same and rest upon said levers *h h′*. When either type-wheel is in use—say the wheel *a′*—its lever *e′* is vibrated by the magnet *d′*, and its pin *m′* will vibrate the auxiliary lever *h′*, and, through the shaft *i*, will vibrate the lever *h′* and rotate the ratchet-wheel *l* and its sleeve and type-wheel *a;* and said wheel *l* will be rotated until the pawl or pallet of *h* arrives at the space 2, where the tooth is removed; and said pawl will then move up and down in said space without turning the wheel *l*, if the lever *h* continues to be vibrated. The type-wheel *a* is now at zero and in unison with the transmitter, ready to be brought into action by that instrument. The wheel *a*, when in use, acts, by its lever *e* and pin *m*, to vibrate the lever *h′*, to rotate the ratchet-wheel *l′* and bring the type-wheel *a′* to unison.

The printing-lever and its magnet are not shown in the drawing. They may be of any desired character, and the magnet may be in a separate electric circuit or in a circuit to the magnets *d* or *d′*. Ordinarily the change in operating the type-wheels will take place at the zero-points; hence the levers *h h′* will not be operative unless there has been a loss in the movement of the type-wheel that is thrown out of action.

I claim as my invention—

Two type-wheels separately revolved by a step-by-step motion, in combination with a separate lever or levers operated by the mechanism that is moving one type-wheel to set the other type-wheel, substantially as specified.

Signed by me this 15th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,336. Patented Sep. 17, 1872.

Fig. 2.

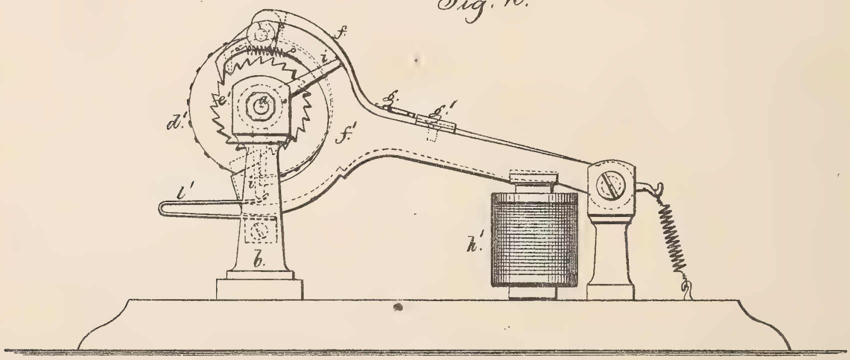
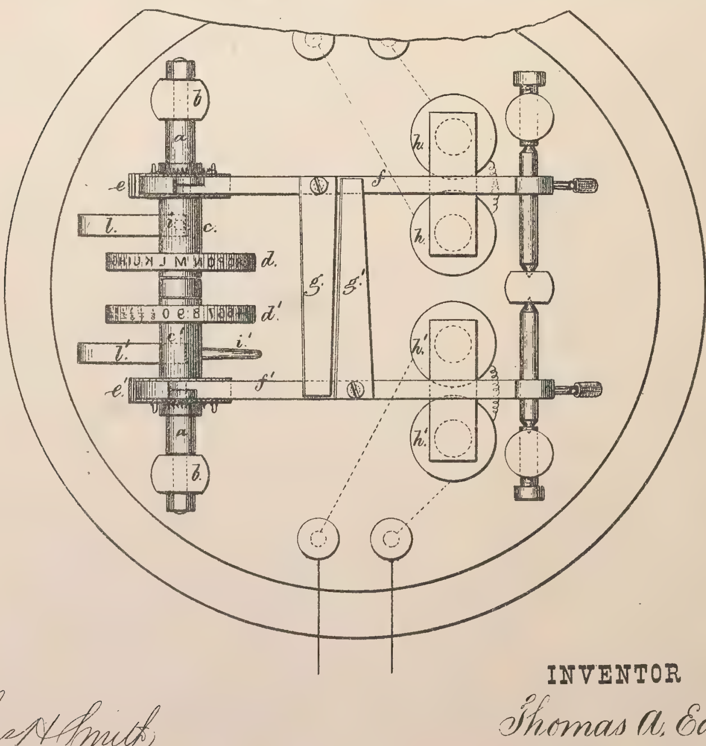


Fig. 1.



INVENTOR

Thomas A. Edison

Pr. Lemuel W. Serrell ATTY.

Chas H Smith

Harold Serrell

Witnesses.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,336**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

In this instrument there are two type-wheels—one a letter-wheel, the other a figure-wheel—both revolving upon a shaft, and each sleeve or shaft and its wheel is actuated by a separate step-by-step movement.

My invention relates to two type-wheel levers connected to each other by yielding or spring arms, so that when one type-wheel lever is vibrated by its magnet and armature to rotate its type-wheel, its spring-arm will act to vibrate the other type-wheel lever and rotate its type-wheel until said wheel is brought to the zero-point and arrested by a yielding unison stop, when the spring-arm will yield, not being of sufficient strength to move said lever against the resistance offered by the unison stop. By this arrangement of parts, if the type-wheel that has been in use is not in unison, the other type-wheel moves it forward until it reaches the zero-point, and is, in unison with the transmitter, ready to be brought into action by that instrument.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is an elevation of the same.

a is a stationary shaft sustained in the standards *b b*, and upon this shaft are sleeves *c c'*, to which are secured the type-wheels *d d'* and ratchet-wheels *e e'*, respectively; or two short shafts may be employed with a central support. The type-wheel *d* is rotated in its step-by-step movement by the electro-magnet *h*, armature and lever *f*, and wheel *e*, and the type-wheel *d'* is rotated by the magnet *h'*, armature and lever *f'*, and wheel *e*, and these magnets *h h'* are in separate electric circuits, or otherwise rendered operative upon their respective armatures. *g* is a spring-arm secured to the lever *f*, and at its outer end resting upon the lever *f'*. *g'* is a second arm secured to the lever *f'*, and resting at its outer end upon the lever *f*. *i i* are the unison arms upon their respective sleeves *c c'*, and *l l'* are yielding stops for said arms to take against in their movement.

If the type-wheel *d'* is in use, and its lever *f'* vibrated by its magnet *h'*, the lever *f* will also be vibrated by the spring *g'* pressing upon the same, and it will continue to actuate said lever and rotate the type-wheel *d* until the arm *i* takes against the stop *l*, as shown in Fig. 2, and stops said wheel at zero. The spring *g'* now ceases to move the lever *f*, but yields each time the lever *f'* is drawn down by its magnet, said arm not having sufficient strength to move the lever *f* and turn the ratchet *e* one tooth to carry the arm *i* past the yielding stop *l*. The arm *g* acts in a similar manner when the lever *f* is vibrated and the type-wheel *d* is in use, and brings the type-wheel *d'* to zero.

It is to be understood that the wheel being printed from is not stopped by the arm *i* or *i'* taking against the stop *l* or *l'*, because the magnet is sufficiently powerful to overcome the resistance of the spring-stop and carry the arm *i* or *i'* past said stop.

The printing may be effected in any desired manner, such as by a printing lever and pad actuated by an electro-magnet in a circuit separate from the magnets *h* or *h'*, or in any of the known modes.

One spring attached at both ends might be employed, instead of the two springs *g g'*.

I claim as my invention—

Two type-wheels actuated by separate step-by-step movements, in combination with a spring arm or arms extending from one lever to the other, and a yielding unison stop for each type-wheel, substantially as set forth.

Signed by me this 15th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

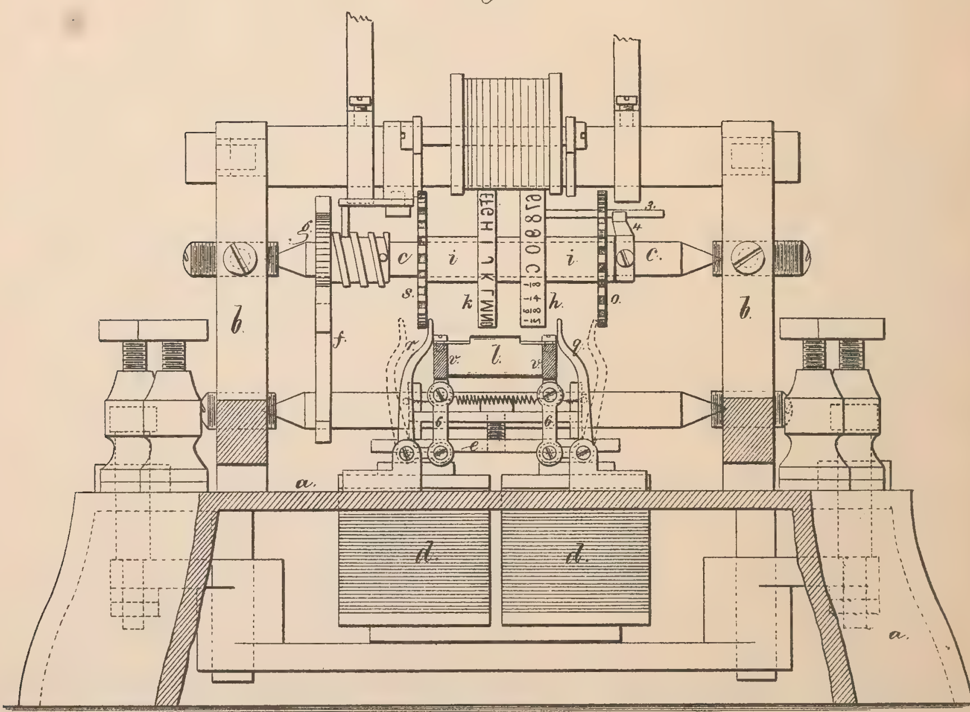
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,337. Patented Sep. 17, 1872.

Fig. 1.



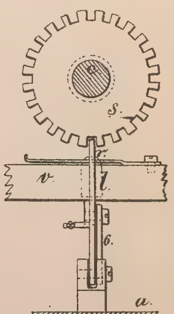


Fig. 2.

Witnesses

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty

N. PETERS. Photo-Lithographer. Washington, D. C.

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,337. Patented Sep. 17, 1872.

Fig. 4.

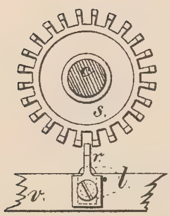
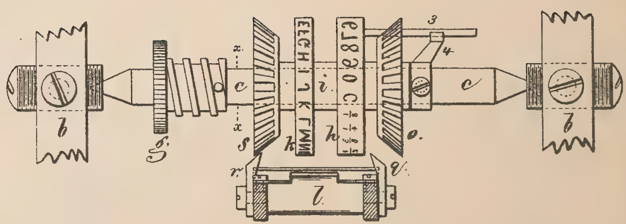


Fig. 3.



Witnesses.

Chas. H. Smith,
Harold Serrell

INVENTOR

Thomas A. Edison,
Per Lemuel W. Serrell
ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,337**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description thereof.

This invention is for shifting the type-wheels lengthwise of the shaft so as to bring one into action and move the other out of action. This has been accomplished by me at certain points in the revolution of the type-wheel by pins upon the printing-lever acting upon a T-lever. I now dispense with the T-lever and provide for means for shifting the type-wheels at any letter. The escapement I employ receives motion from a magnet, and the type-wheels are rotated half of the space between one letter and the next when the circuit is closed, and the other half by the movement of the lever when the circuit is open; and the two type-wheels are so applied that the characters on one are in line for printing with the closed circuit and the other in line for printing with the open circuit. Notched wheels are applied at the sides of the type-wheels, and projections are moved by the printing-lever, so that if the type-wheel to be printed from is not in position the parts will be moved in the act of operating the printing-lever. It is to be understood that this printing instrument is operated by two line-wires on separate circuits, one through the printing-magnet and the other through the type-wheel magnet, and that a number of instruments can be used in the same circuits.

In the drawing, Figure 1 is an elevation, with the bed in section, of my instrument. Fig. 2 is a view of the notched wheel and lever endwise of the shaft. Fig. 3 shows the type-wheels, shaft, and notched wheels in a modified form; and Fig. 4 is a view endwise of the shaft, showing the notched wheel and actuating tooth.

The bed *a*, frame *b*, type-wheel shaft *c*, and type-wheel magnet *d* are of usual character. The armature *e* moves the step-by-step escapement or wedge-acting pallets of the lever *f* so as to move the wheel *g* and shaft *c* progressively half a letter space as the magnet *d* is energized, and the other half space when the magnet is discharged. The type-wheels *h k* are placed upon the sleeve *i*, that can slide endwise upon the shaft *c*, and is guided by the rod 3 and arm 4, and the position of these type-wheels is such that a plane passing through the center of a letter on the wheel *h* will pass midway between two letters or characters on the wheel *k*; hence the characters on *h* will be in line with the impression-pad *l* for printing when the circuit through *d* is kept closed, and the characters on the wheel *k* will be in line for printing with the circuit open. In order to print from only one of the type-wheels it is necessary that either the type-wheels should be moved endwise or that the printing-pad should be moved from beneath one wheel to the other. I accomplish this by means of wheels *o* and *s*, that are notched around their edges with as many notches as there are type or letter spaces in the wheels; and these are placed in such position to the type-wheels that they control the impression. In Figs. 1 and 2 there are levers *q* and *r*, that are moved by the links 6 that connect with the printing-lever *v*; hence, each time the printing-lever is actuated the upper ends of these levers *q* and *r* swing outwardly. If the type-wheel requires to be shifted to print on an open circuit (when it had been printing on a closed circuit) the end of the lever *r* will come in contact with the projection of the wheel *s* and slide the type-wheels endwise and bring the type-wheel *h* into line for printing, and at the same time the end of the lever *q* will pass through one of the notches in *o*. The reverse movement will take place when the printing-lever is actuated while the type-wheel is held by its magnet on a closed circuit, so that the operator can select either type-wheel and impress a character from either the one or the other. The same end movement is given to the type-wheels by the mechanism shown in Figs. 3 and 4, in which the faces of the wheels *o s* are conical and are acted upon by the inclines *q* or *r* that take the place of the levers in Figs. 1 and 2; and it will be evident that if the printing-pad was mounted so as to be shifted endwise in a transverse slide upon the printing-lever it might be done by either of the movements aforesaid, and in that case the type-wheels and wheels *o* and *s* would remain stationary upon the shaft *c* and the printing-pad slide beneath them. A shield of thin sheet metal, with an opening through which the

impression is made, may also be employed, and either slide with the printing-pad or this shield alone may be moved transversely by the aforesaid mechanism to allow of the printing being from only one of the type-wheels at a time.

I claim as my invention—

1. The notched wheels *o s*, in combination with the type-wheels *h k*, and mechanism, substantially as set forth, for moving the type-wheels or the printing-pad, or shield to select the type-wheel from which the impression is to be made, substantially as set forth.

2. Two type-wheels, with the characters of one in line with the spaces between the characters on the other, and a step-by-step movement that is operative when the electric circuit is both closed and opened, in combination with the notched wheels *o* and *s*, and mechanism for selecting the type-wheel to be printed from, substantially as set forth.

3. The conical-faced notched wheels *o s*, in combination with the inclined stops *q r* and type-wheels *h* and *k*, substantially as set forth.

4. The swinging levers *q* and *r*, actuated by the printing-lever *v*, in combination with the type-wheels *h* and *k* and notched wheels *o s*, substantially as set forth.

5. The combination of two type-wheels and a printing-lever, with mechanism moved by the printing-lever, substantially as set forth, for printing from one type-wheel when the type-wheel circuit is open and from the other when that circuit is closed, substantially as set forth.

6. A shifting movement derived from the printing-lever, operating in one direction with a closed circuit and in the other direction with an open circuit, substantially as set forth.

Signed by me this 10th day of June, 1872.

T. A. EDISON.

Witnesses:

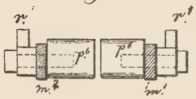
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,338. Patented Sep. 17, 1872.

Fig. 3



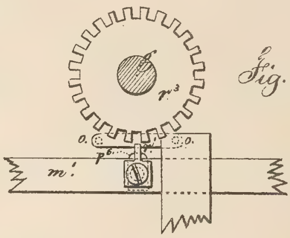
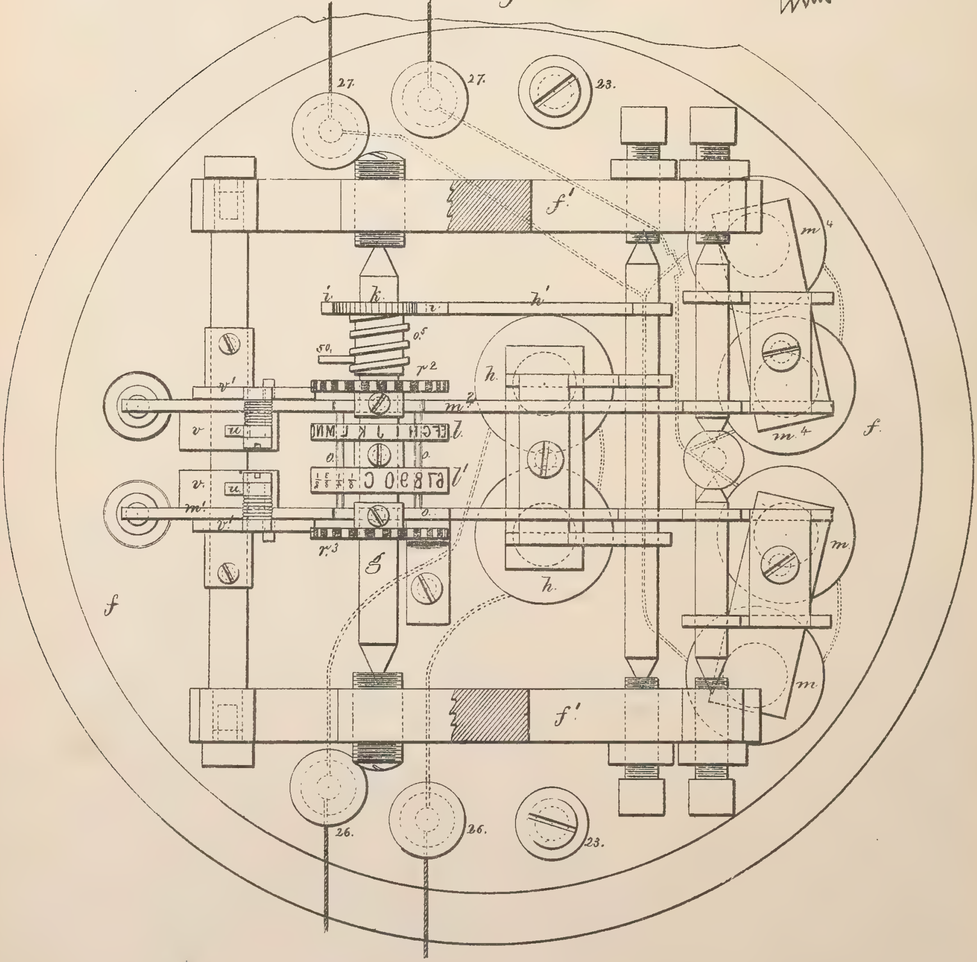


Fig. 2

Fig. 1.



INVENTOR

Thomas A. Edison

Per. Lemuel W. Serrell ATTY.

Witnesses.

Chas. Smith

Harold Serrell

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,338**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same:

The printing-lever is made in two parts, with a pad to each; the electric pulsation passes through the two magnets that operate these printing-levers, but there is not any impression from one of the two type-wheels, because the movement of its lever is arrested by a projection on the printing-lever coming against one of the teeth of a wheel that is moved with the type-wheels; the other type-wheel is printed from because the space between the teeth is in line with the projection on the printing-lever, and hence does not check its movement.

In the drawing, Figure 1 is a plan of my improved instrument; and Figs. 2 and 3 are detached views of the same.

The shaft g of the type-wheels l l' is sustained by the frames f' on the bed f, as usual. The type-wheel magnet h is energized by pulsation through the line-wires connected at 26. The lever h' and pallets i act to rotate the toothed wheel k and shaft g, as in other printing-telegraphs, and the screw-unison o^5 and stop 50 are similar to those in patents heretofore granted to me. The magnets m m^4 are in the electric circuit from the wires 27, either by passing through all the helices or by dividing the current so that half passes through each magnet. The drawing shows by dotted lines the connections arranged so that the current is divided between m and m^4, and both magnets will be energized when an electric circuit is completed through 27. The type-wheels l l' are placed, as shown, with the spaces in one opposite the types in the other, hence the types in l will be in line for impressing, with a closed circuit, and those in l' in line for impressing with an open circuit. The notched or toothed wheels r^2 r^3 are positioned similarly to the type-wheels l l', and upon the levers m^1 m^2 are projections r r^1; hence, with a closed circuit through h the wheels r^2 r^3 will be in such a position that the projection r will pass into the notch in r^2, and the lever m^2 and its pad p^6 be moved freely and give the impression; but an impression will not be given by the lever m^1 because its projection r^1 is stopped by one of the teeth on r^3. If the circuit through 27 is closed when the circuit through h is broken, the wheel l' will be printed from, as its projection r^1 will pass into one of the notches in r^3, as seen in Fig. 3, and the impression will not be made from l, because the stop r of m^2 comes in contact with one of the teeth of r^2. The guide-wires and frame o are held by a bracket to the bed f and keep the strip of paper in position relatively to the type-wheels. The feeding-pawls n act against the turning segments v, and they are actuated by the levers v^1 and the respective printing-levers m^1 m^2 when either one is moved, and one pawl, n, holds the paper as the other draws back.

I claim as my invention—

1. The wheels r^3 r^4, projections r r^1, and levers m^1 m^2, in combination with the type-wheels l l', substantially as set forth.

2. Two separate printing-levers and their respective magnets in the same or branch circuits, in combination with two type-wheels, positioned as specified, and mechanism substantially as set forth, for preventing an impression from one of the type-wheels while the other is being printed from, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

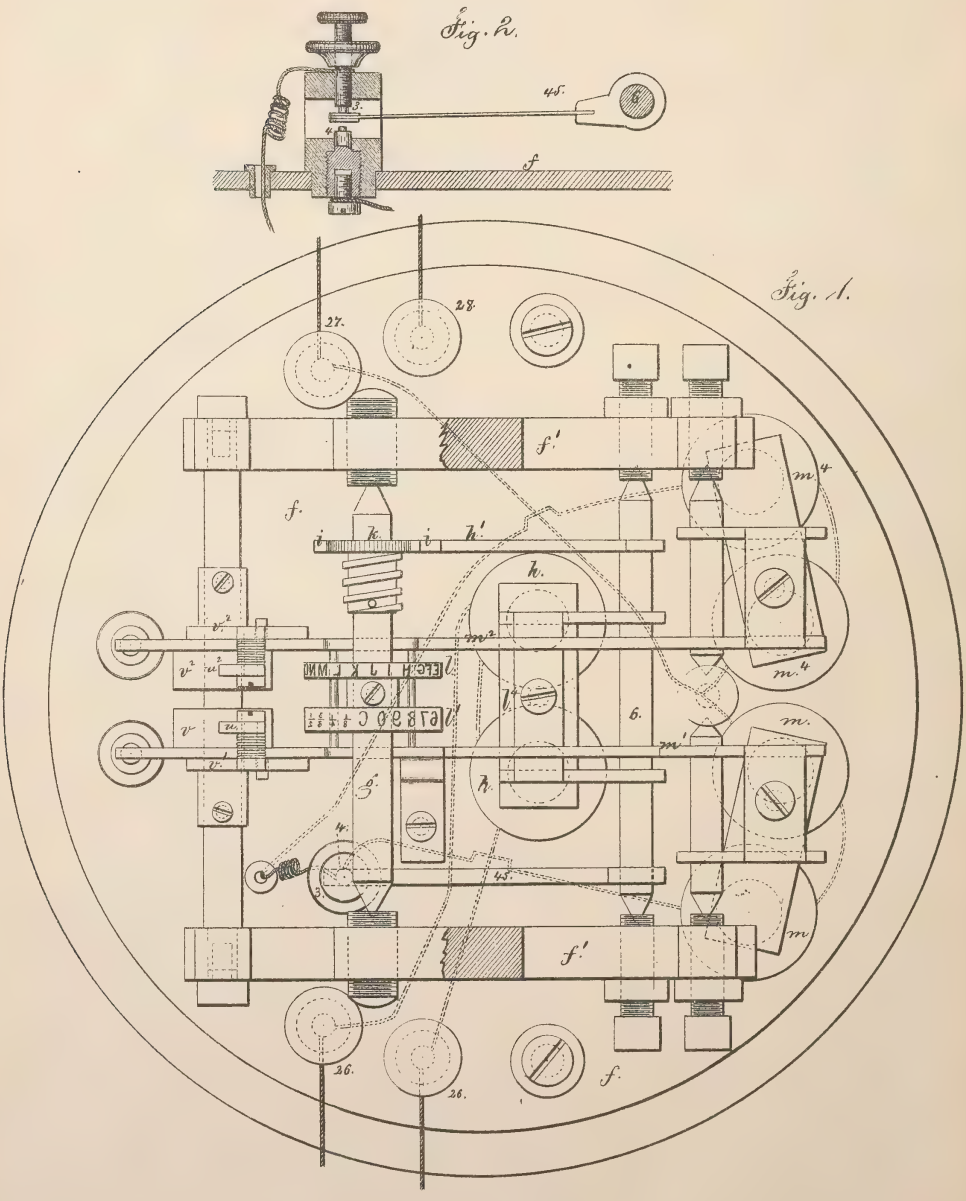
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,339. Patented Sep. 17, 1872.



Chas H Smith

Harold Serrell

Witnesses.

INVENTOR

Thos A. Edison,

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,339** dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

In this telegraph there are two type-wheels, two printing-levers, and contiguous printing-pads, and there is a separate magnet to each printing-lever. The step-by-step movement revolves the type-wheel, and there is a half-space moved by the pallets when the circuit to the printing-magnet is closed, and the other half space is moved at the reverse movement of the armature away from the magnet. The type-wheels are positioned so that the letters in one are in line with the spaces between the letters in the other. An arm is provided that vibrates with the armature of the type-wheel magnet, and acts as a circuit-closer, so that when the type-wheels are stopped with the armature drawn toward the type-wheel magnet this circuit-closing arm will complete the circuit to the magnet that acts upon the proper printing-lever. The circuit to the other printing-lever is closed by the rising of the armature from the type-wheel magnet. This instrument is adapted to printing letters from one type-wheel, and numbers and fractions from the other wheel, and either can be brought into action at any time, the letters being in position with a closed circuit, and the numbers in position with the open circuit through the type-wheel magnet, or the reverse. Two line-wires, of course, are required to operate a number of instruments; one goes through the type-wheel magnets and the other through the printing-magnets. The general characteristics of this machine are the same as those heretofore described by me in other applications for patents, except in the particulars hereafter described.

In the drawing, Figure 1 is a plan, and Fig. 2 is a detached sectional view of my improved instrument.

The type-wheel magnet h is in the electric circuit to the line-wires 26. Its armature l^4 acts upon the levers h' and pallets i to move the toothed wheel k, shaft g, and type-wheels l l^1 half a space on the type-wheels as the circuit is closed through h, and the other half as the circuit is broken and the armature retracted by a spring. The spring-arm 45 is upon the shaft 6, and moved at the same time as the armature l, and plays between the circuit-closers 3 and 4. When the circuit through h is closed one character on the type-wheel l' will be in line for printing, and the spring 45 will close the circuit from 27 through the magnet m, closer 4, spring 45, shaft 6, frame f', bed f, and binding-screw 28 to the line; hence, the lever m^1 will be operated to impress from the type-wheel l^1, and by the clamp and pawl u v and lever v^1 to feed the paper as soon as a pulsation is sent through 27. If the type-wheels are stopped with circuit through h broken, the circuit-closer 45 will be in contact with 3; hence, a pulsation through 27 will pass by the magnet m 4, closer 3, spring 45, shaft 6, frame and bed f' f to 28, and operate the printing-lever m^2 and give an impression from the type-wheel l, and by the clamps and pawls v^2 u^2 and lever v^2 feed the paper. By this arrangement either type-wheel can be printed from at pleasure, and there are not any parts to shift or change.

I claim as my invention—

The circuit-closing arm 45 and connections 3 4 to the respective magnets m m^4, in combination with the printing-levers m^1 m^2, type-wheels l l^1, and actuating mechanism, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing-Telegraphs.

No. 131,340. Patented Sep. 17, 1872.

Fig. 2.

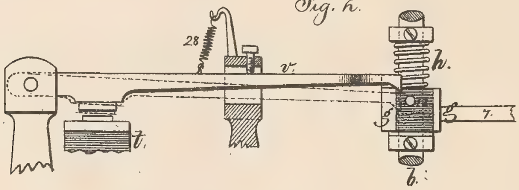
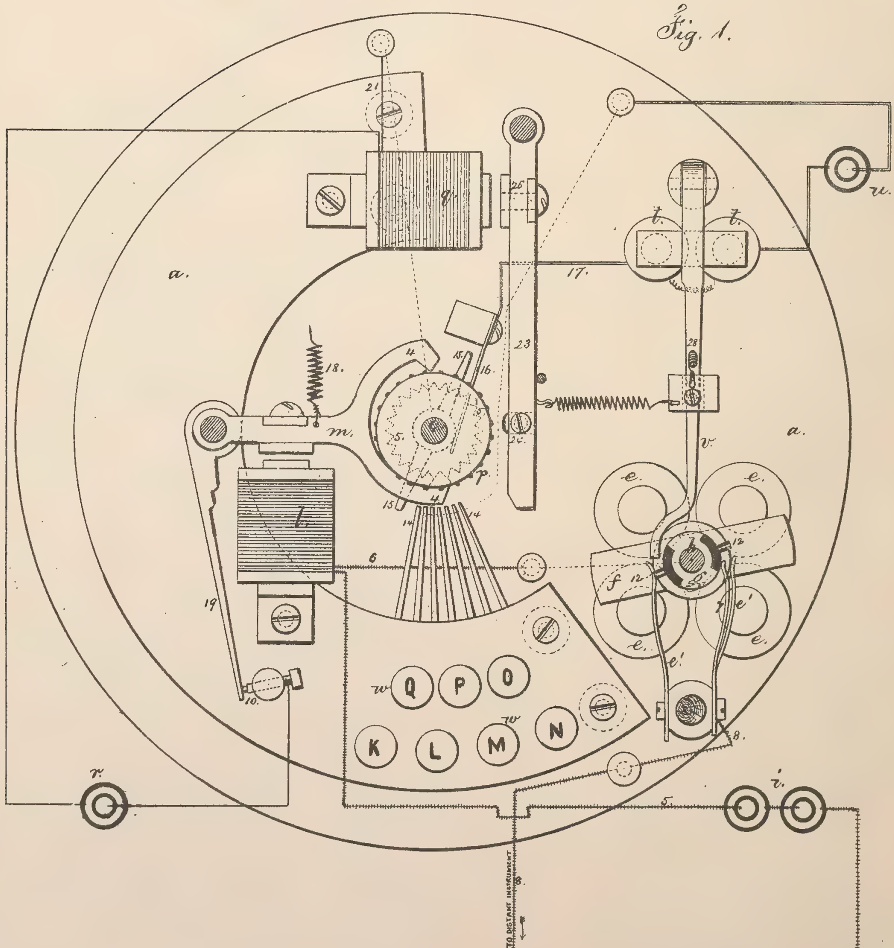


Fig. 1.



INVENTOR

Chas H. Smith

Harold Serrell Witnesses.

Thomas A. Edison,

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,340**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments; and the following is hereby declared to be a full and correct description of the same.

In this instrument an electro-motor gives rotation to a vertical shaft, and upon this shaft is a pulsator which makes and breaks the circuit to the type-wheel magnet, and, by the pulsations transmitted, revolves the type-wheel and its shaft by a step-by-step motion.

The present improvement relates to means for arresting the rotation of the pulsator, when a finger-key is depressed, so as to break the circuit to the type-wheel magnet of the distant instrument or instruments in the circuit, and stop the type-wheels so that the desired letter may be printed by an electro-magnet that is brought into action by the act of arresting the movement of the type-wheel.

Upon the type-wheel shaft is an insulated arm, and when a key is depressed one end thereof is brought into the path of this arm, and stops the movement of the shaft and closes a circuit through a magnet which draws down an armature and lever, and brings the outer end of the lever in the path of a pin upon the pulsator, stopping the same upon the open circuit of the type-wheel magnet, and hence arresting the movement of all the type-wheels in that circuit; at the same time a local circuit to the printing-magnet is closed and the printing is effected.

In the drawing, Figure 1 is a sectional plan of said instrument, and Fig. 2 is a detached view of the pulsator and its stop-lever and magnet.

a represents the bed of the machine, and in suitable steps or bearings are mounted the pulsator and type-wheel shafts *b* and *c*, respectively. The shaft *b* is revolved continuously by suitable power, such as the electro-motor, composed of the helices *e e*, armature *f*, and connections (not shown in the drawing) from the springs *e′* to a battery, and upon this shaft is the pulsator *g*, composed of alternate conductors and non-conductors, and said pulsator revolves with said shaft *b* by frictional contact derived from the spring *h*. This pulsator *g* makes and breaks the circuit to the battery *i* through the type-wheel magnet *l*, moving its armature and lever *m*, and communicating, by the pallets 4 4 and ratchet-wheel 5, the necessary step-by-step movement to the shaft *c* and its type-wheel *p*. This circuit from the battery *l* is from the battery *i*, by wire 5, to said magnet *l*, thence, by wire 6, to the bed of the machine, and by shaft *b*, pulsator *g*, spring-arm 7, and wire 8, to distant instrument, and by return wire or earth, back to battery.

When it is desired to stop the type-wheel at a particular letter and impress the same, the pulsator *g* must be arrested in its movement, and with the spring-arm 7 upon a non-conducting part of *g*, so as to break the circuit to the type-wheel magnets *l* and close a local circuit at 10 to the printing-magnet *q* from the battery *r*.

I arrest the movement of the pulsator as follows: *t t* is an electro-magnet in a circuit to the battery *u*, and when said magnet is charged its armature is attracted and the lever *v* drawn down to the position shown by dotted lines in Fig. 2, bringing its outer end into the path of one of the pins 12 12, which project from the non-conducting portions of the pulsator *g*, thereby stopping its movement.

When one of the range of finger-keys is depressed its outer end 14 is moved into the path of the insulated arm 15 on the type-wheel shaft *c*. This stops the revolution of that shaft *c* with the designated letter in position for printing, and at the same time closes a circuit through the hub of 15 and insulated spring 16, wire 17, magnet *t*, to the battery *u*; thence, by the bed *a* and finger-key arm 14, to the arm 15. The magnet *t* attracts its armature and brings the outer end of the lever *v* into the path of the pin 12, so as to take against one of said pins, as aforesaid, and stop the revolution of the pulsator.

The pins 12 are so located that when the pulsator is stopped the spring arm 7 is upon an insulated part of *g*; hence the circuit to the magnet *l* is broken and the armature and lever *m* are drawn away from the magnet *l* by the spring 18. This brings the arm 19 in contact with the screw 10, closing the circuit to the battery *r*, and the current from the same passes by 10, 19, *m*, *c*, *a*, and wire 21 to the magnet *q*

to charge the same and attract the armature 26, and effect the impression by the lever 23 and pad 24.

When the finger is removed from the depressed key *w* said key rises and the circuit is broken at 14 15 to the magnet *t*, and the lever *v* is drawn up by its spring 28, liberating the pin 12, and the pulsator again revolves with the shaft *b*, and makes and breaks the circuit to the magnet *l*, as aforesaid.

It is to be understood that the contact of 19 and 10 is so momentary that when the type-wheel shaft *c* is being revolved the magnet *q* does not become sufficiently charged to effect the printing.

It is also to be understood that the finger-keys are to be extended to form a semicircular range, or otherwise positioned to include all the characters, and that the other parts may be arranged in relation to each other in the most convenient positions. The paper-feed may be of any desired character.

I claim as my invention—

1. The pulsator, acting to make and break the circuit to the printing-magnet *l*, in combination with the arm 15, electro-magnet *t*, and connections for arresting the pulsator simultaneously with the stopping of the type-wheel, substantially as set forth.

2. An electric circuit closed by the contact of the revolving arm 15 with the finger-key stop 14, in combination with the type-wheel and actuating mechanism, substantially as set forth.

3. The arm 19, moved by the escapement-lever *m*, and acting to close the circuit to the printing-magnet *q*, in combination with the pulsator *g*, magnet *t*, and circuits, substantially as set forth.

Signed by me this 10th day of June, A. D. 1872.

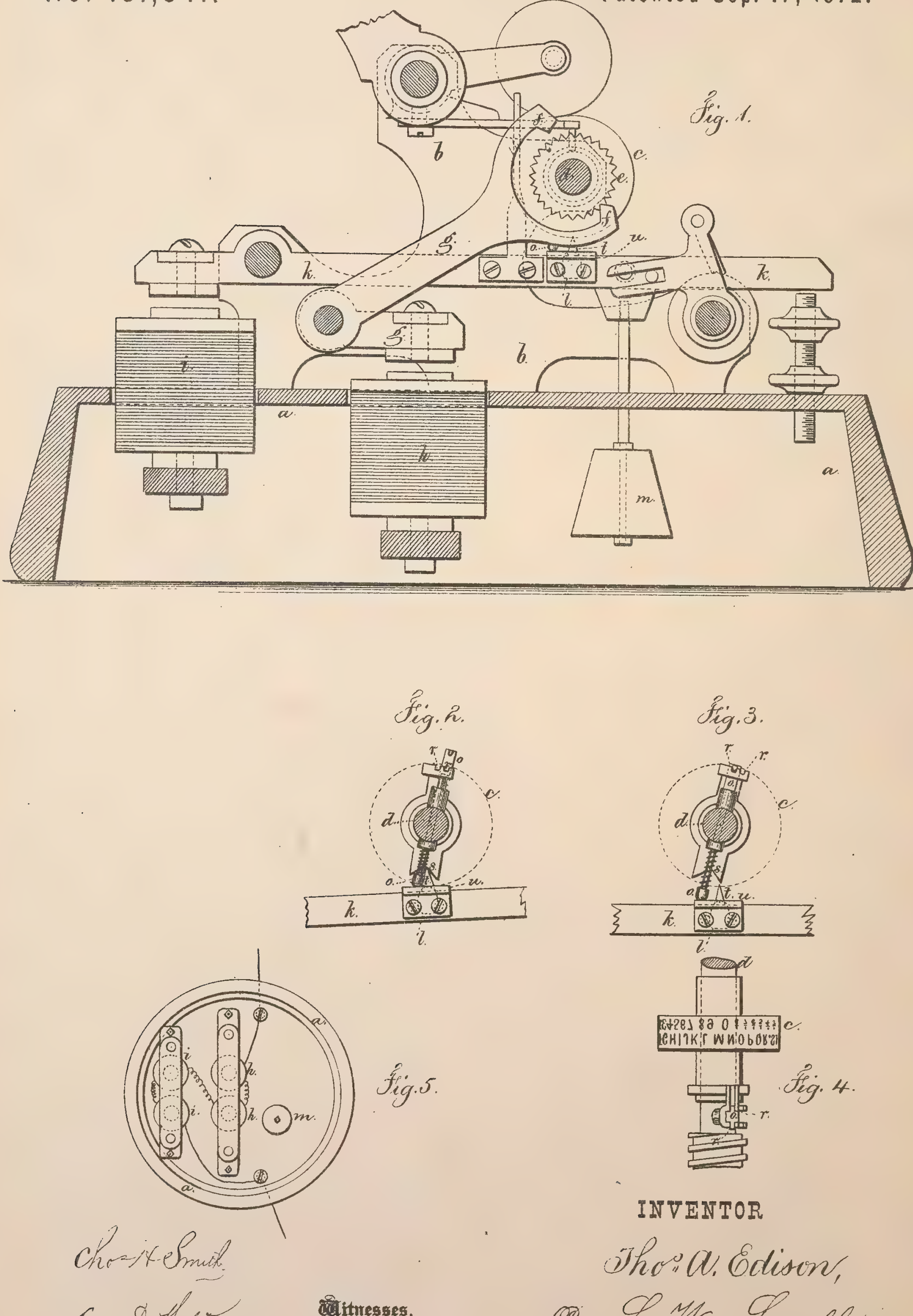
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,341. Patented Sep. 17, 1872.



INVENTOR

Chas. H. Smith

Geo. D. Walker

Witnesses.

Thos. A. Edison,

Per. L. W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **131,341**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

Before my present invention the printing-lever magnet had been placed in the same circuit as the type-wheel magnet, and the former had been prevented from giving an impression each pulsation by a spring acting upon the printing-lever; but unless the pulsations that set the type-wheel lever were very rapid, the printing-lever would be moved more or less. If the spring is under considerable tension, so as to prevent an impression until a pause occurs after the type-wheel has been set, the printing-magnet accumulates sufficient force to overcome said spring; but the impression is not reliable, because the spring prevents the pad giving a blow, and the said spring accumulates resisting power to the action of the magnet as the printing-lever is moved.

My present invention is made for effecting the printing by a blow resulting from the motion of a weighted lever. The weighted lever resists the action of the printing-magnet, so as not to move until the force of the electro-magnet is sufficient, and then the inertia of the moving weight insures a sufficiently-powerful blow to print from the type-wheel. In this manner a series of printing-telegraph instruments can be worked successfully in a one-wire circuit, and all polarized switches and electrical circuit-changers are dispensed with. I also make use of a mechanism for turning the type-wheel partially around upon its shaft, to bring one range of letters or figures into position and take out of action the intermediate figures.

In the drawing, Figure 1 is a longitudinal section of the said machine, and Figs. 2, 3, and 4 are detached views of the type-wheel shifting mechanism.

The base *a*, frame *b*, type-wheel *c*, shaft *d*, ratchet-wheel *e*, and pallets *f*, moved by the lever *g*, are of usual construction, and the type-wheel magnet *h* and printing-magnet *i*, are of ordinary character, and may be either in one electric circuit, or in separate circuits, although especially designed for use in one electric circuit, as represented in Fig. 5. The printing-lever *k* and pad *l* are also of ordinary construction, with the exception that the weight *m* is attached to said lever *k*, in order that it may prevent the printing-lever acting when the magnet *i* is only slightly energized; but when said magnet is sufficiently powerful to move the weight and lever, said weight gives the necessary blow to effect the printing much more perfectly than can be done with the same electric current and a spring to restore the printing-lever to a normal position. The type-wheel *c* is to be made with the desired letters or characters in two ranges—for instance, numbers may be placed between the letters to alternate with them, or the numbers may be upon a separate type-wheel, the characters of one coming opposite the spaces of the other, and the step-by-step motion is sufficient to move the type-wheel from one letter or character to the next in either range; hence one of the ranges will be out of action and the other in position; and to change so as to print from the range that had been out of action requires that the type-wheel or wheels shall be rotated upon the shaft a distance equal to half the movement given by one of the step-by-step motions. I effect this by the movement next described. Across the shaft *c* is the spring-locking bolt *o*, having a T-head, and upon the sleeve carrying the type-wheel or wheels is an arm having notches, *r*, at one end for the T-head of the bolt *o* and at the other end a fork, *s*, for the stud *t* upon the impression-lever *k*. A plate, *u*, upon the impression-lever acting upon the bolt *o*, raises its T-head out of one of the notches *r*, and at this time the type-wheel can be partially rotated. If the position of the parts is such that the stud *t* acts against the fork *s*, the type-wheel will be moved either one way or the other, according to which side of the fork said inclined stud *t* takes against as the printing-lever rises, the bolt *o* being disconnected, and upon the printing-lever falling, the T-head of the bolt secures the parts in position by entering one of the notches *r*.

It is to be understood that the operator at the transmitting-station can shift all the type-wheels at once in the various machines in the electric circuit by bringing them around to the point where the stud of the printing-lever

will operate upon the proper inclined side of the fork *s*, and then actuating the printing-lever to disconnect the bolt *o* and then turn the type-wheel or wheels *c* to bring one range of types into action and turn the other range around, so that the impression-pad will not act against either of the types therein; but it will be below the space between the types in one range of type, and impress from the types of the other range of types.

I claim as my invention—

1. The printing-lever and weight, in combination with the type-wheel and an electro-magnet, for the purposes and as set forth.

2. The bolt *o*, notches *r*, and fork *s*, in combination with a type-wheel or wheels having two ranges of figures or letters and the printing-lever and stud *t*, as and for the purposes set forth.

3. The combination, in one electric-circuit, of two or more type-wheel magnets, and two or more printing-magnets, and two or more weighted printing-levers, substantially as set forth, whereby the printing will be effected by the same pulsation used to bring the type-wheel to place, but only when the printing-magnet has accumulated sufficient force to give a blow by the weighted printing-levers, substantially as set forth.

Signed by me this 28th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

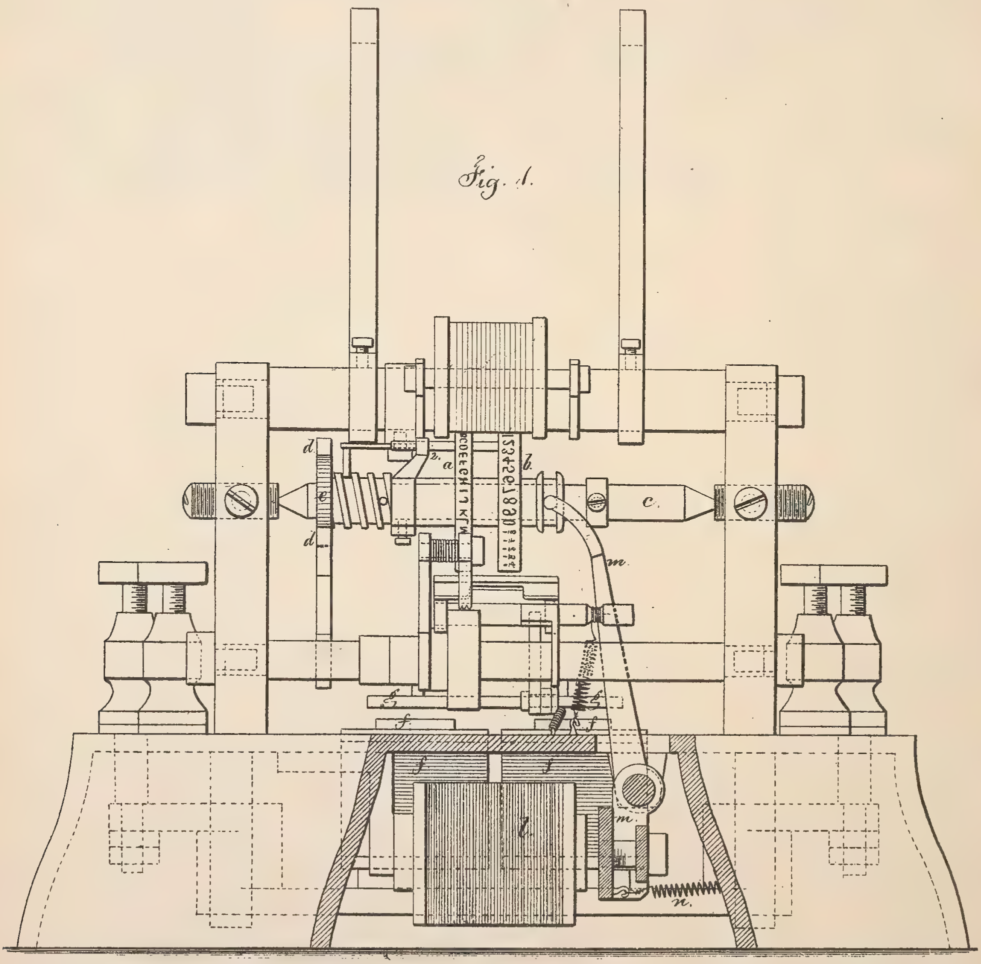
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,342. Patented Sep. 17, 1872.

Fig. 1.



Witnesses.

Chas H Smith

Geo. D. Walker.

INVENTOR

Thos A. Edison,

Per. Lemuel W. Serrell

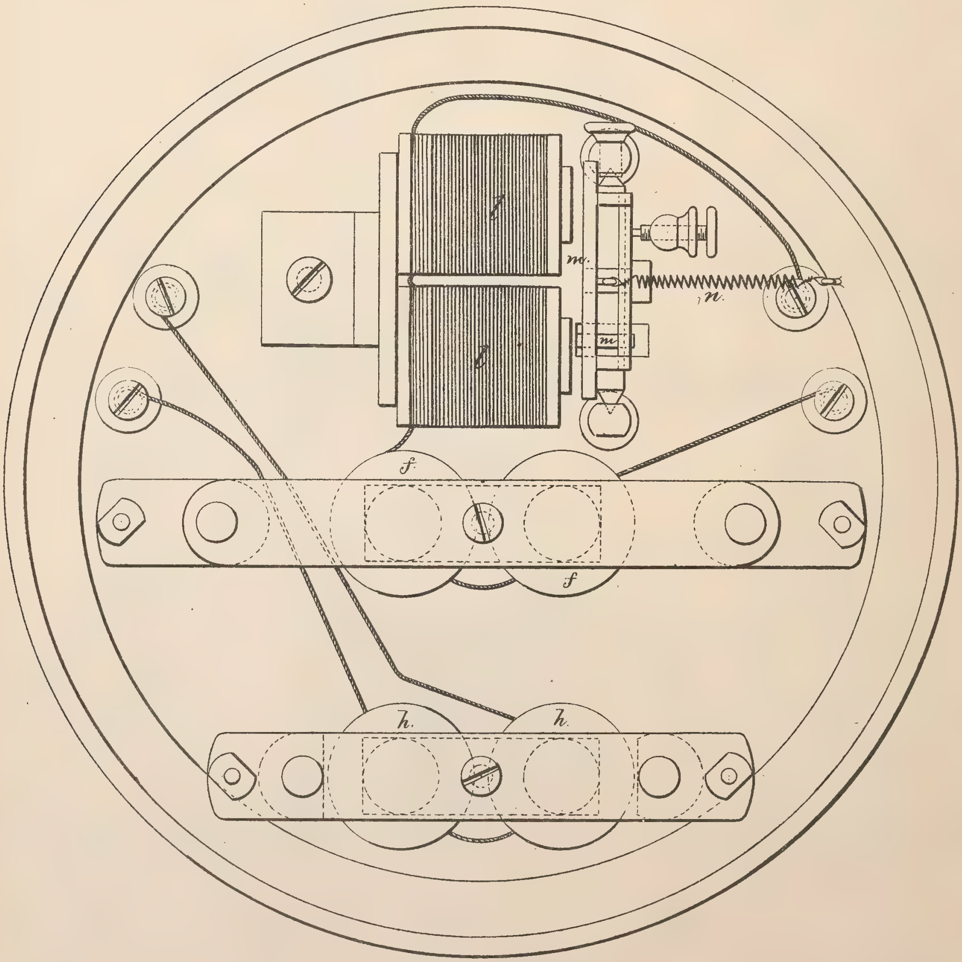
ATTY.

T. A. EDISON.

Improvement in Printing Telegraph Instruments.

No. 131,342. Patented Sep. 17, 1872.

Fig. 2.



INVENTOR

Chas H Smith

Witnesses.

Geo. D. Walker

Thos. A. Edison,

Per. L. W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **131,342**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

The present invention applies to improvements applicable with other printing-telegraphs heretofore made and patented by me.

I make use of two type-wheels sliding endwise of the actuating-shaft, the one having figures or fractions, or both, and the other letters, and these are positioned so that when the circuit to the type-wheel magnet is closed and held during the energizing of the printing-magnet by a separate electric circuit, the letter-wheel will be drawn by a magnet into position for printing, and when the circuit is broken the figure-wheel will assume its position over the paper to be impressed. The magnet that gives endwise movement to the type-wheels, not being energized, allows a spring to give the reverse movement. By this means the letter and type wheels are moved around to the required point; and if a letter is to be impressed, the circuit is kept closed; or if a figure, the circuit is broken before impression, or the reverse. In this manner circuit-changers and polarized bars can be dispensed with and the end movement of the type-wheel is independent of any unison or changing points, as either wheel can be brought into or removed from action at any point of the revolution.

In the drawing, Fig. 1 is an elevation; and Fig. 2 is an inverted plan of the instrument.

The type-wheels *a b* are connected by a sleeve and slide freely endwise of the shaft *c*, and are guided by the rod 2, that also serves to communicate to the wheels the rotary motion of the shaft. The step-by-step movement of the type-wheels is given by the pallets *d*, acting upon the ratchet-wheel *e*, and *f* is the type-wheel magnet, the armature *g* of which moves the lever and pallets *d*. The printing-magnet *h* is in a separate circuit from the type-wheel-magnet, so that the printing is effected independently of the type-wheel magnet, but switches or polarized bars might be employed to direct the current through the magnet employed to shift the type-wheel, if desired. The type-wheel shifting-magnet *l* is provided with an armature and lever, *m*, the upper end of such lever being connected with the type-wheel sleeve by a fork and groove or other convenient means. When the magnet *l* is energized it shifts the type-wheels in one direction by sliding them endwise of the shaft, but when the electro-magnet *l* is not energized the spring *n* returns the parts to their former position. The magnets *l* and *f* are shown in the same electric circuit, and the magnet *l*, acting the most slowly, may hold the parts in position while the type-wheel is being set. Hence the impression will be on the letter-wheel *a*, with a closed circuit; but if the circuit of *l* is opened the type-wheels will be moved endwise, and bring the figure-wheel *b* into position for printing. If the ratchet and pawls forming the step-by-step movement are constructed to move one-half a tooth at each vibration in opposite directions, then the types on one wheel will have to be in line with the spaces in the other.

I claim as my invention—

1. Two type-wheels, sliding endwise of the shaft, in combination with an electro-magnet, to move such type-wheels in one direction, and a spring, or its equivalent, to return the type-wheels to their former position, substantially as set forth.

2. An electro-magnet in the same circuit as the printing-magnet, and operating to give end motion to two type-wheels when the circuit is closed, in combination with a magnet in a separate circuit, to give the impression, substantially as set forth.

Signed by me this 9th day of May, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

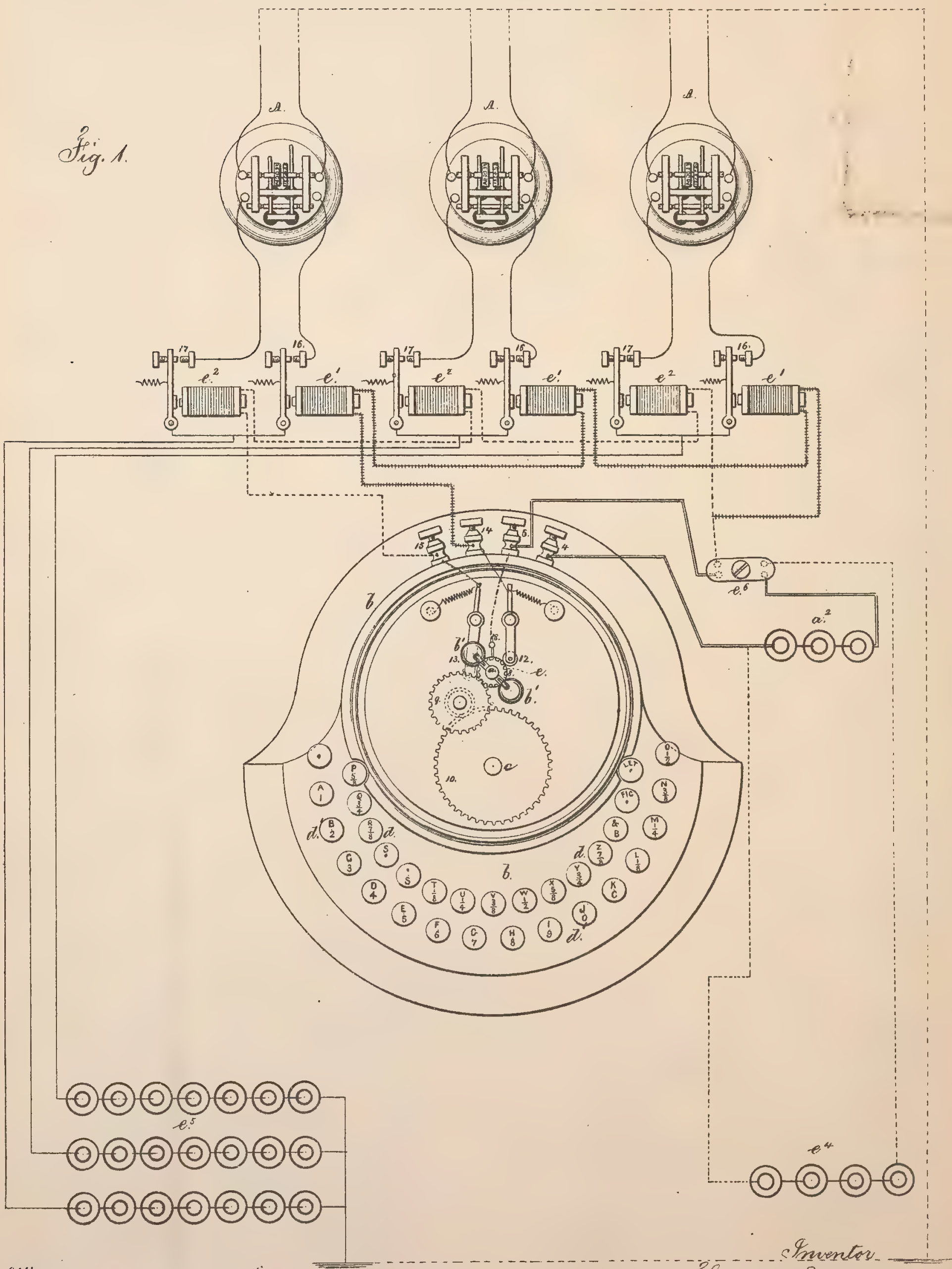
2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Transmitters and Circuits for Printing-Telegraphs.

No. 131,343. Patented Sep. 17, 1872.

Fig. 1.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison,
Lemuel W. Serrell
Atty.

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Transmitters and Circuits for Printing-Telegraphs

No. 131,343. Patented Sep. 17, 1872.

Fig. 3.

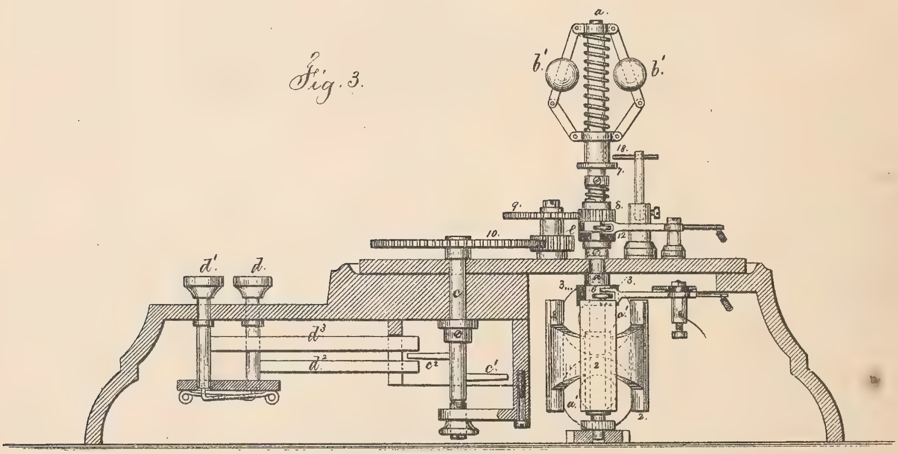
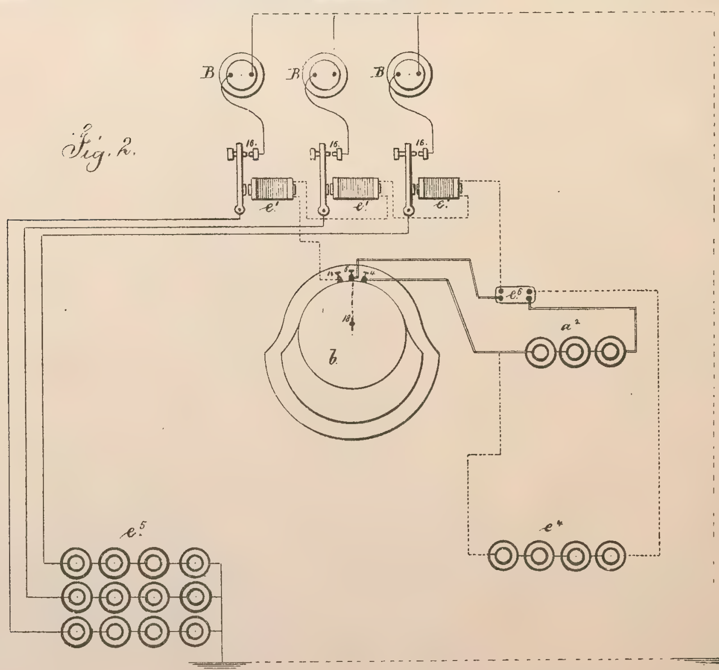


Fig. 2.



Witnesses
Chas H Smith
Harold Serrell

Inventor
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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TRANSMITTERS AND CIRCUITS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,343**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Printing-Telegraphs, and the following is declared to be a correct description of the same.

The first part of this improvement relates to a machine that is termed a "transmitter," in which there are finger-keys or stops that are alloted to the respective characters employed. There is also in this instrument a "pulsator," that makes and breaks an electric circuit passing through a range of relay-magnets and opens and closes these until the pulsator is stopped by the depression of one of the finger-keys. The second part of this invention relates to the arrangement of the respective electric circuits that connect this transmitter with the relay-magnets and the circuits that are operated by those relay-magnets and pass through the printing-telegraph instruments, a number of these instruments being placed in each circuit, so that one transmitting instrument will operate in unison any number of printing-telegraph instruments to the extent of hundreds, and in case of defect in any one local circuit the other circuits will not be disarranged.

In Figure 1 a plan of the transmitter is shown, also a diagram representing the circuits to the relay-magnets and printing instruments, in which two wires are employed, one wire and circuit to the type-wheel magnets, the other to the printing-magnets. In Fig. 2 a diagram is shown of the transmitter and circuits to printing-telegraph instruments, operated by one wire and electric circuit; and Fig. 3 represents the transmitting instrument by a vertical section.

The shaft a of the transmitting instrument is preferably revolved by magnetism. For this purpose two stationary magnets are used, one of which, a^1, is seen in Fig. 3; and there are three armatures, 2 2 2; and upon the shaft a is a circuit-breaker, 3, of alternate conducting and non-conducting material, that opens and closes the circuit to the magnets a^1 alternately, so as to attract the armatures successively and revolve the shaft a. The battery a^2 operates this motor, the wires being connected at 4 to the bed b of the machine, and at 5 to the insulated binder, and from that to the magnets a^1 and to the lever and roller 6 of the respective pulsators, thence through the shaft a and bed b to 4. Upon the shaft a are governor-balls b', that rise by increased speed and bring the flange 7 of the sliding sleeve into contact with the adjustable insulated arm 18, Fig. 3; and from this a wire connects with 5, thereby the electricity will be "short circuited," passing through 4, b, a, 7, 18, and 5, instead of going through the electro-magnets a^1, thus lessening the power and the speed, and maintaining uniformity in the revolution of the motor. By the gearing 8 9 10 the shaft c is revolved with the desired speed. It has two arms, c^1 c^2, on opposite sides, one above the other, and these act in connection with the two semicircular ranges of finger-keys d d^1. Beneath the bed b these finger-keys have arms d^2 d^3 converging toward the center of c, and when one of the keys d^1 is depressed its arm d^3 stops the arm c^2, shaft c, and gears 8 9 10. The gear 8 is driven by friction, hence the motor and shaft a continue to revolve; but connected with the gear 8 is a pulsator, e, made of alternate conducting and non-conducting surfaces, and these open and close the circuits to the distant printing instruments or to the relay-magnets. By bearing in mind that the parts are made so that the pulsator e transmits the necessary number of pulsations to make a complete revolution of the type-wheels at the distant instruments by a step-by-step movement, each complete revolution of the shaft c, it will be understood that the shaft c and the type-wheels revolve in harmony, and that when the shaft c is stopped by one of the keys d or d^1 the type-wheels of the distant instruments are stopped, and the position of the characters on the type-wheels must be in harmony with the arrangement of the keys d d^1, and when the key is liberated the shaft c and pulsator e resume their revolution, and the distant type-wheels also resume the synchronous movement. The printing-telegraph machines illustrated at A A are operated by two wires. Those shown at B B, Fig. 2, are operated by one wire; hence with two-wire instruments two ranges of relay-magnets, e^1 e^1 and e^2 e^2, will be required, while only the range e^1 of relay-magnets will be needed with one-wire instrument. When two ranges of relay-magnets are used there are two rollers, 12 and 13, on insulated spring-levers. One is connected to the binding-screw 14, the other to the binder 15, and the parts are po-

sitioned so that the pulsator e, as it revolves, opens and closes the circuit from the battery e^4 through the relay-magnet e^1 to make and break the circuits at 16, from the batteries e^5 through the type-wheel electro-magnets in the distant instruments A. The relay-magnets e^2 will not respond although the circuit is closed by the roller 13, because the springs of the armatures of the electro-magnets e^2 are under considerable tension; but when the pulsator e is stopped by depressing one of the keys the roller 12 rests upon a non-conducting surface, breaking the circuit through e^1, and the roller 13, resting on a conductor, closes the circuit through the relays e^2, causing them to close the circuits at 17 of the batteries e^5; hence they act in the distant instruments A in the electro-magnets that effect the printing. The pulsator e, when employed with the single range of relay-magnets e^1, as in Fig. 2, causes the pulsations to be repeated at 16 from the batteries e^5 to the distant instrument, and when the printing is effected by a pause on a closed circuit, the pulsator e is stopped with the roller 12 in contact with the metallic portion of the pulsator; but if the printing is effected by a pause upon an open circuit the roller 12 is in contact with a non-conducting portion of the pulsator e. I have shown the battery e^5 in three sections connected with the respective relay-magnets and with three relay-circuits. In each of these relay-circuits there may be any desired number of printing-telegraph instruments, and the circuits are completed through the ground connections. The circuits to the transmitting instrument and the relay-magnets may be disconnected by a switch at e^6, that may be turned around to throw both batteries out of action, and the circuits from the batteries e^5 will also be broken at the relay-magnets.

I claim as my invention—

1. The pulsator e, driven by friction, in combination with the ranges of finger-keys and the arms c^1 c^2, substantially as and for the purposes set forth.

2. The revolving pulsator e in combination with the relay-magnets and connections of the local and main-line circuits, substantially as set forth, for actuating the printing-telegraph instruments in their respective circuits, substantially as set forth.

3. The governor b' and flange 7, in combination with the circuit connections to the magnets of the motor, substantially as and for the purposes set forth.

Signed by me this 10th day of June A. D. 1872.

T. A. EDISON.

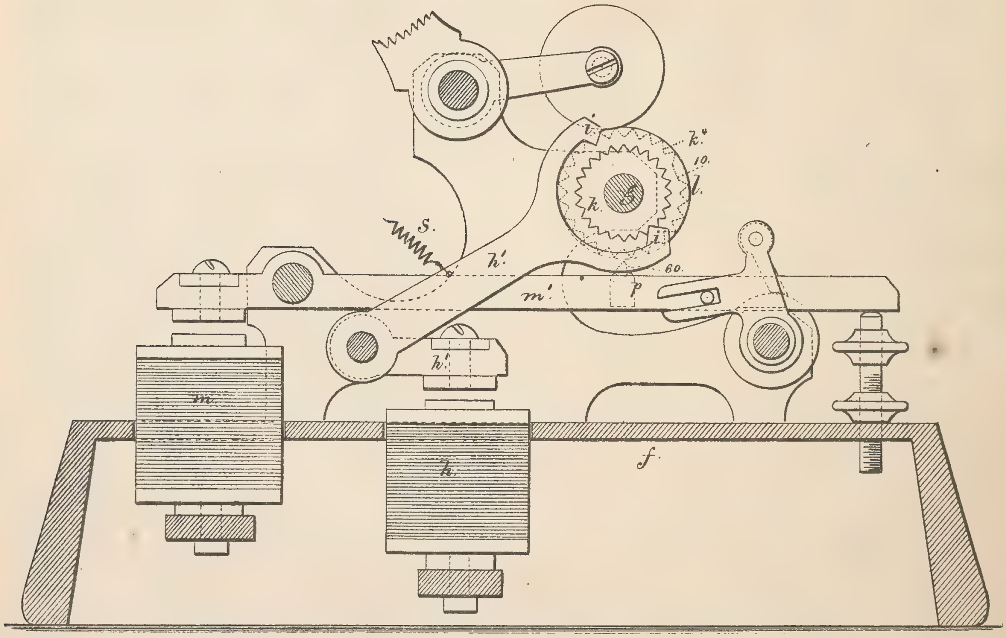
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Unison-Stops for Printing-Telegraphs.

No. 131,344. Patented Sep. 17, 1872.

Fig. 1.



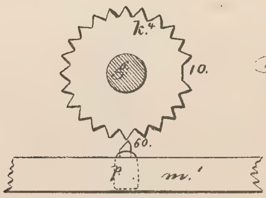


Fig. 2.

INVENTOR

Thomas A. Edison,

Chas H. Smith

Harold Serrell

Witnesses.

Per. Lemuel W. Serrell

ATTY.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN UNISON-STOPS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **131,344**, dated September 17, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs; and the following is declared to be a correct description of the same.

This invention is devised for rotating the type-wheel around to a unison-point by the action of a wedge-shaped tooth on the printing-lever operating upon a toothed wheel on the type-wheel shaft; thereby a number of machines in an electric-circuit are brought to a unison-point by pulsations through the printing-lever.

In the drawing, Figure 1 is a section showing the type-wheel and wedge-acting escapement, and Fig. 2 is a detached view of the unison-wheel and tooth.

The bed f, type-wheel l, shaft g, printing-magnet m, type-wheel magnet h, and printing-lever m', are of the usual character. The wedge-acting pallets i i of the type-wheel lever h' act upon the ratchet-wheel k, and give the type-wheel l a progressive movement, step by step, the pallets i being placed so that the type-wheel is moved half a space as the magnet h is energized, and the other half space is moved by the spring s acting upon the lever h', when the pulsation in h is arrested. Upon the printing-lever m' is a pallet or tooth, 60, and upon the type-wheel shaft g is a toothed wheel, k^4, with one tooth removed at the point where the type-wheels will be brought into unison.

The operation is as follows: Ordinarily the impression from the type-wheel by the printing-pad p will be made when the circuit through h is broken, and the parts in the position shown in Fig. 1, in which case the tooth 60 moves in between the teeth of k^4 without acting to turn the same; but when the machines are to be brought to unison, the circuit through h is kept closed, and the pallet i moves the type-wheel l and wheel k^4 half a space, so that the latter is in the position to the tooth 60, shown in Fig. 2; the printing-magnet m is then energized by a series of pulsations, and as the printing-lever m' moves, the tooth 60 rotates the wheel k^4 and type-wheel l around until the space 10, formed by the removal of one of the teeth of k^4, reaches the tooth 60, and hence there can be no further motion of the type-wheel, because the tooth 60 has nothing to act against, and thereby the type-wheels of the various printing-telegraph machines in the line will all stop when they arrive at the unison-point, even though the levers m' are still operated to bring into unison any type-wheels that may not have arrived at that point. During these motions, the upper pallet i yields as the shaft g and wheel k are turned, and this pallet i acts as a pawl to prevent a reverse movement. The type-wheel will not be printed from in these movements, because the pad p is brought up at the space between one type and the next, the pallets i being in the reverse position to that occupied by them when the printing is effected.

I claim as my invention—

1. The wheel k^4 and tooth 60, actuated by the printing-lever m', in combination with the type-wheel l, wheel k, and pallets i, substantially as and for the purposes set forth.

2. Adjusting the type-wheel to the unison-point by the movement of the printing-lever while the type-wheel pallets are in the opposite position to that which they occupy when the type-wheel is being printed from, substantially as set forth.

Signed by me this 29th day of June, A. D. 1872.

T. A. EDISON.

Witnesses:
GEO. D. WALKER,
GEO. T. PINCKNEY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PAPER FOR CHEMICAL TELEGRAPHS, &c.

Specification forming part of Letters Patent No. **132,455**, dated October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Preparing Chemical Paper or other material for telegraphic purposes; and the following is declared to be a correct description of the same.

Before my invention iodide of potassium had been employed in the preparation of chemical paper for receiving telegraphic communications by dots and dashes, and starch had been mixed with this solution of iodide of potassium to cause its adhesion to the paper. In receiving telegraphic communications, while the paper remained damp, this operated very well, but when the paper became dry the starch was liable to crack and peel off.

My invention is made to avoid the before-named difficulty, by using a vehicle for the iodide of potassium that will not crack or scale off the paper when dry. In order to make use of the starch in the solution, it is necessary to use hot water or to boil the same, otherwise the starch will not remain with uniformity throughout the solution during the soaking operation to which the paper is subjected.

I have discovered that a very thin paste made of flour and water will retain the iodide of potassium uniformly in solution during the soaking operation to which the paper is subjected; it will not make the paper hard or brittle, but will penetrate the fabric, and no portion of the surface will crack or scale off when the paper becomes dry. Furthermore, during the time that the paper is kept moist ready for use, there is but little tendency to deteriorate or become injured by atmospheric influences, especially if kept in tin cans or jars, and if the paper becomes too dry it can easily be remoistened.

I prefer that the flour and water be mixed together while the water is warm, and, I remark, that fine wheat flour is the best, but rye or other flour may be employed.

I claim as my invention—

The chemical paper for telegraphic purposes, prepared in the manner specified.

Signed by me this 10th day of April, A. D. 1872.

T. A. EDISON.

Witnesses:

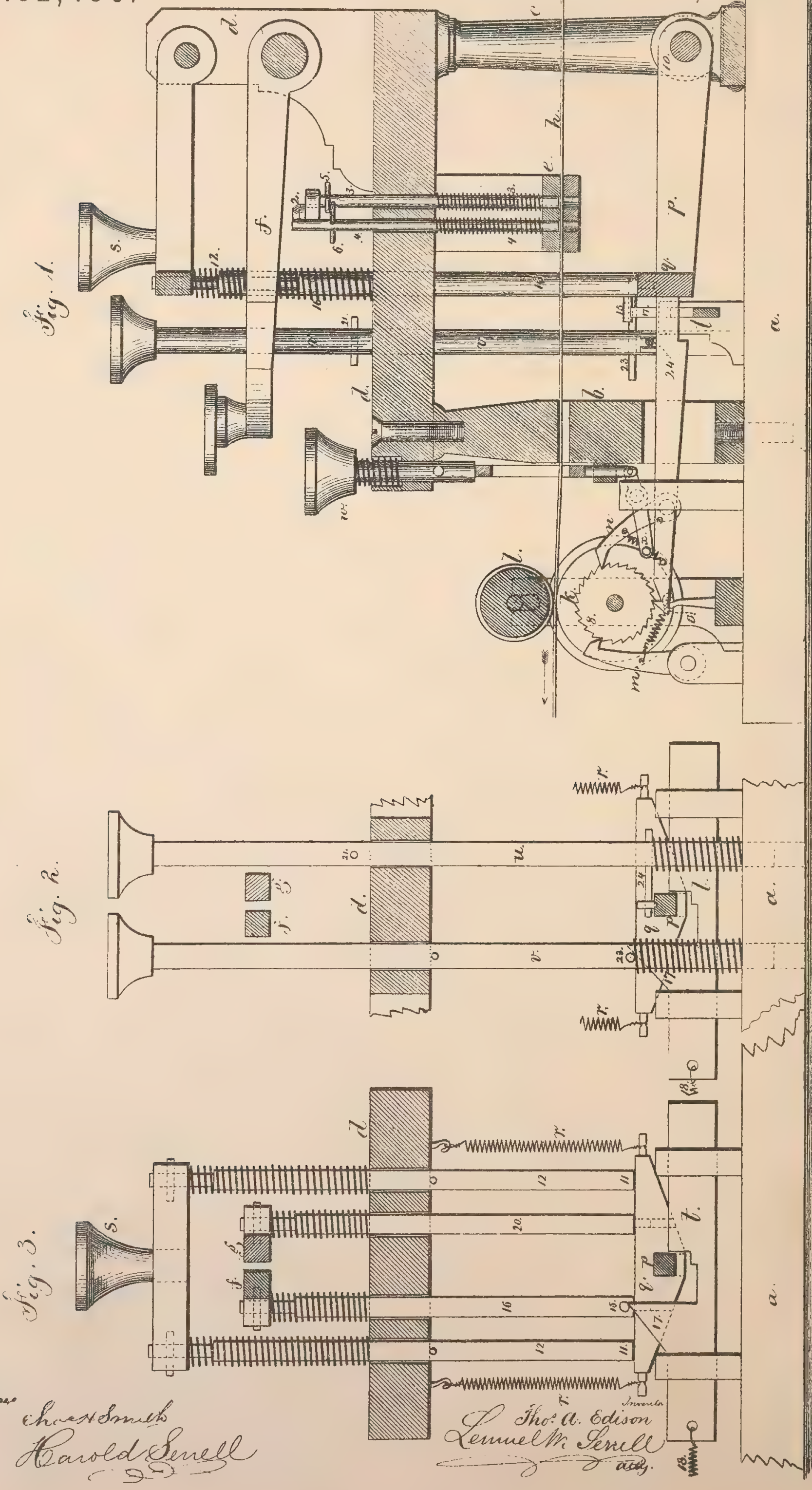
GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Improvement in Apparatus for Perforating Paper for Telegraphic Use.

No. 132,456. Patented Oct. 22, 1872.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
Lemuel W. Serrell
atty.

2 Sheets--Sheet 2.

T. A. EDISON.

Improvement in Apparatus for Perforating Paper for Telegraphic Use.

No. 132,456. Patented Oct. 22, 1872.

Fig. 5.

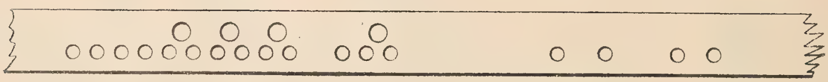
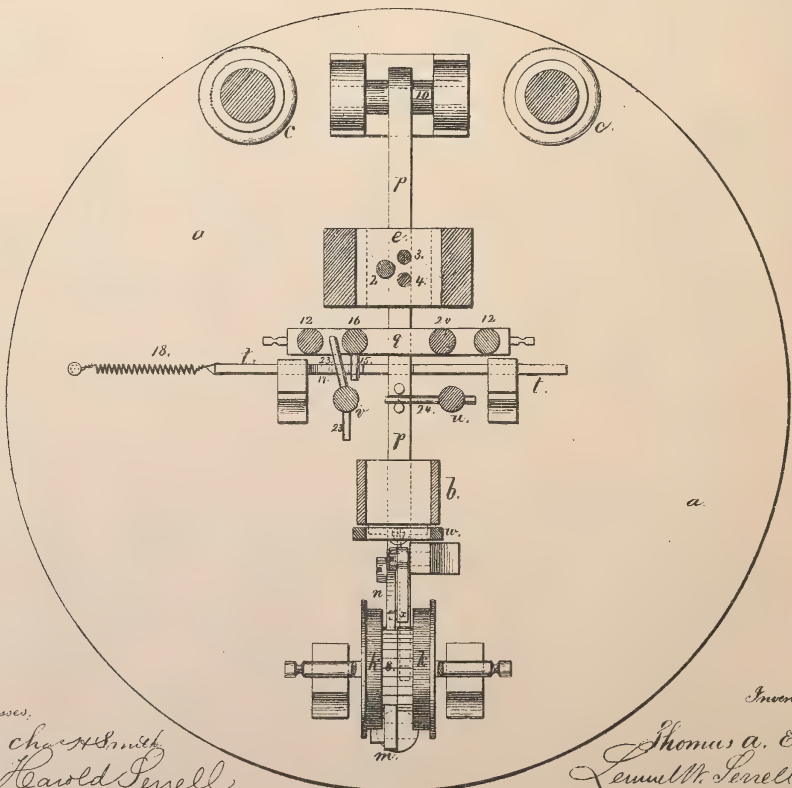


Fig. 4.



Witnesses.

Chas H Smith
Harold Serrell

Inventor.

Thomas A. Edison
Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN APPARATUS FOR PERFORATING PAPER FOR TELEGRAPHIC USE.

Specification forming part of Letters Patent No. **132,456**, dated October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Perforating-Machines, and the following is declared to be a correct description of the said invention.

The strip of paper is perforated by this machine for use in transmitting telegraphic messages. The machine is made with keys that perforate either a single dot or three openings to form a dash, one of the three openings being larger than the others so as to produce a longer pulsation. The paper is fed the proper distance each perforation, and word-spaces, pauses, and sentence-spaces are produced by keys, and these keys are arranged in a small compass, and the instrument is compact, cheap, and adapted to local offices or to individual use.

In the drawing, Figure 1 is a vertical section centrally of the machine and in line with the strip of paper; Fig. 2 is an elevation of the spacing-bars for words and sentences; Fig. 3 is an elevation of the spacing-bars for the letters and pauses; Fig. 4 is a sectional plan at the plane of the paper; and Fig. 5 shows a piece of the perforated paper.

The bed *a* carries the standards *b c* and frame *d*. The die *e* is made with three openings, as in Fig. 4, for the three punches 2 3 4 that are raised by springs and depressed by the key-lever *f* so as to punch the three holes at once, or when the key-lever *g* is depressed only the punch 4 is moved. In Fig. 1 it will be seen that the lever *f*, acting on the upper end of 2, carries that down, and by the arm 5 and pin 6 the punches 3 and 4 are also moved, but the pin 6 being below the arm 5 the punch 4 can be moved down separately. The perforation from the punches 2, 3, and 4 represents a dash, and in consequence of the punch 2 being the largest it removes sufficient paper to insure a metallic contact of the brush or transmitting-stylus between one of the smaller perforations and the other, thereby producing a dash-mark. Upon each depression of the key *f* or *g* the paper-feeding mechanism is operated so that as the key is raised the feed takes place sufficiently to produce the required space between one letter and the next. The paper *h* passes above the die *e* and through the slotted standard *b* between the feed-roller *k* and holding-roller *l*. The roller *k* is made with the ratchet-teeth 8 in the middle, and *m* is the stop-pawl; *n*, the actuating-pawl on the lever *p*; and *o* is the stop or blocking pawl on the lever *p* taking the second range of reverse ratchet-teeth. The lever *p* has its fulcrum at 10, and receives more or less vibration according to the amount that the paper is to be fed. The yoke *q* and springs *r* serve to raise the lever *p* to its full height, as determined by the stops 11 on the rods 12, and these rods 12 extend to the key *s* that gives motion to the lever *p* sufficient to space off between one word and the next, as at a pause. The movement of the lever *p* is arrested by the notched slide *t*, see Fig. 3, and this slide *t* is moved endwise to bring a deeper notch below the lever *p* and allow greater motion when the dash key-lever *f* is depressed, because the pin 15 upon the slide-rod 16 running down the incline 17 on *t* moves the same endwise against the action of the spring 18, when the said key-lever *f* is struck. When the dot key-lever *g* is struck the slide 20 moves the lever *p* and feeds the paper the same distance as when the space-key *s* is depressed. The slide *u*, with a knob at its upper end, has a movement limited by the stop 21 and by the pin 24, moves the lever *p* and paper only a short distance, sufficient to separate one word from another, but the slide *v* with its pin 23 acting upon the incline 17, and also upon the yoke *q* of the lever *p*, depresses the latter to its full extent and feeds the paper a distance to denote the end of a sentence. In case the lever *p* should be depressed its full extent and it is desired to shorten the length of paper-feed the pawl *n* is lifted out of the ratchet-teeth 8 by the swinging finger and pin *x* that is actuated by the slide and key *w*, so that as the lever *p* rises the pawl will go forward and take the ratchet-teeth, but only move the feed-roller a short distance.

I claim as my invention—

1. Perforations for dashes in telegraphic transmitting-paper composed of two small and an intermediate large perforation, as specified.

2. A perforating mechanism composed of three punches in combination with two keys, arranged substantially as specified, so that all

three punches will be actuated by one key and only one by the other key, as set forth.

3. A feeding-roller actuated by a lever and pawl in combination with the perforating-punches and keys, and intervening mechanism for regulating the movement of the lever in proportion to the length of feed-movement required for the paper.

4. The notched slide *t* in combination with the lever *p* and keys for spacing the distance between the perforations, substantially as set forth.

5. The finger *x* actuated by the key *w* in combination with the pawl *n* and paper-feeding lever *p*, substantially as set forth.

Signed by me this 15th day of March, 1872.

T. A. EDISON.

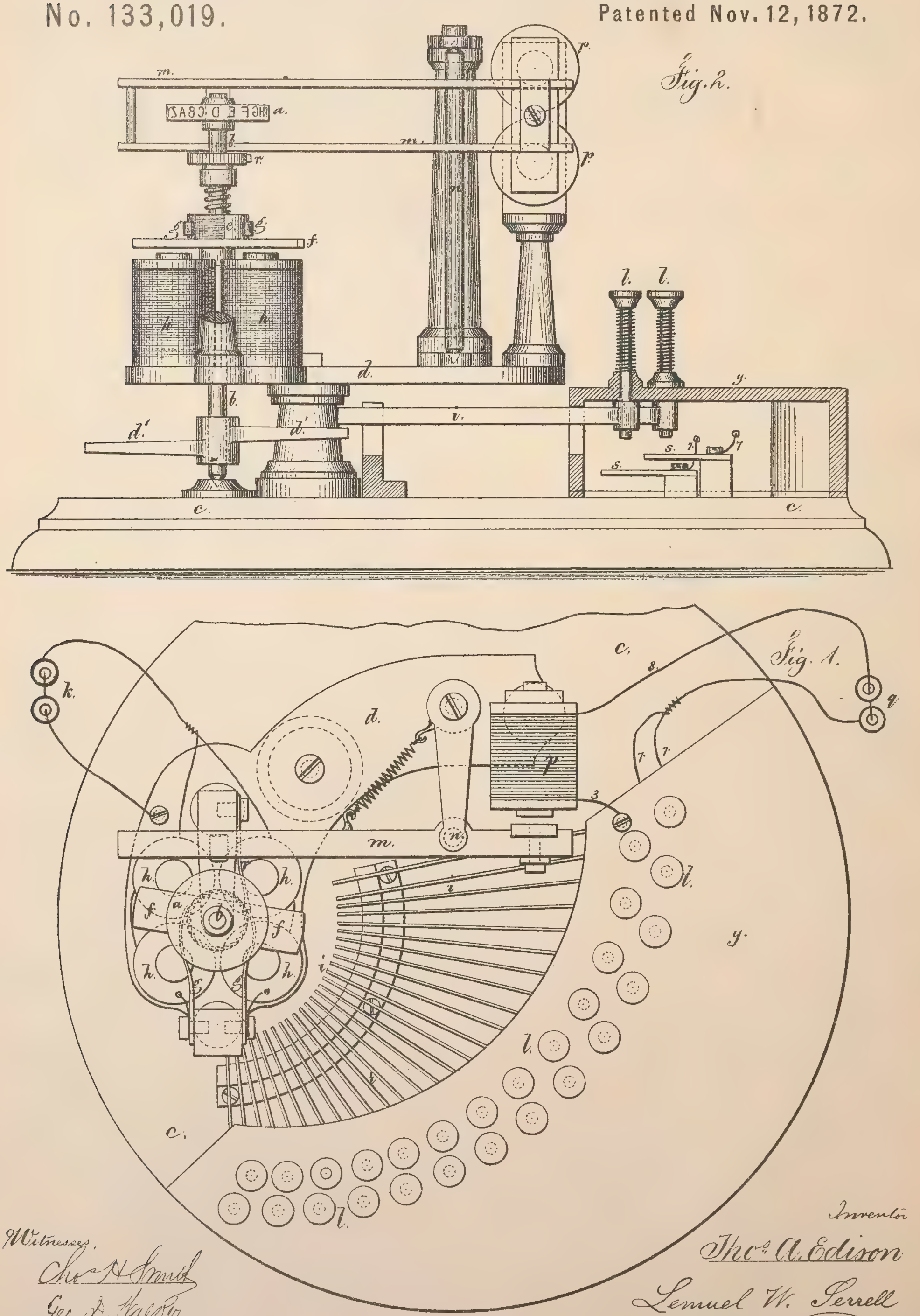
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Improvement in Electrical Printing-Machines.

No. 133,019. Patented Nov. 12, 1872.



Witnesses,
Chas. H. Smith
Geo. D. Walker

Inventor
Thos. A. Edison
Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN ELECTRICAL PRINTING-MACHINES.

Specification forming part of Letters Patent No. **133,019**, dated November 12, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electrical Printing-Machines; and the following is declared to be a correct description thereof.

This invention is intended for printing upon a strip or sheet of paper by a type-wheel, so that messages, instead of being written, can be printed off by touching finger-keys. The machine is also available for printing copies of documents or composing and printing instead of writing.

I make use of a type-wheel upon a shaft that also carries an armature and circuit-breaker that is driven by a magnetic motor, the said armature propelling the said shaft by frictional contact. Upon the shaft is an arm that is stopped by one of a range of keys, these being positioned so that the type-wheel, with the corresponding type, will be stopped at the position to be impressed. The depression of the finger-key completes a circuit to a magnet that gives the impression.

In the drawing, Figure 1 is a general plan of the machine; and Fig. 2 is an elevation, partially in section, of the same.

The type-wheel *a* is upon a shaft, *b*, in suitable bearings in the bed *c* and frame *d*. Affixed to this shaft *b* are also the arm or arms *d'* and the armature *f* and circuit-breaker *e* to the springs *g;* and this armature and circuit-breaker are connected to the shaft by a friction-coupling, so that they can easily revolve the shaft when free; but when the shaft is stopped the armature will continue to revolve. The electro-magnets *h* and the connections from the battery *k* to form, with the armature *f*, an electro-motor are known, and do not require further description. The finger-keys *l* are arranged so as to move a projection, *i*, to each key into the path of the arm *d'*, so as to arrest the movement of the arm and type-wheel when the former comes into contact with the projection *i* of the depressed key. These projections *i* are arranged circularly, and, if positioned in a circle, then only one arm, *d'*, will be required. If positioned in a half circle, they must be in two rows, one above the other, and two arms, *d'*, will be required, as shown. The printing-lever *m* is on a fulcrum, *n*, and is operated upon by the magnet *p*, the connection for this magnet from the battery *q* being completed by the depression of the finger-key, causing the slide-rod of said key to stop upon the insulated plate *s*, one pole of the battery being connected therewith by the wire or wires 7, and the other, by the wire 8, to the magnet *p;* and from the latter there is a connection, 3, to the metallic plate *y* carrying the keys *l*. The impression-lever is made with any suitable feeding device for moving a strip of paper along or presenting a sheet, line after line, to the type-wheel.

It will now be understood that the magnetic motor maintains a rapid rotation of the type-wheel until one of the keys is depressed, which arrests, by its projection *i*, the arm *d'* and type-wheel, the latter having a corresponding letter opposite the impression-pad, and instantly the impression is given by the action of the electro-magnet *p*.

A stop-pawl, *r*, prevents any risk of rebound when the arm is arrested by the stop *i*.

I claim as my invention—

1. The type-wheel and shaft, revolved by friction from the armature of an electro-motor placed upon the type-wheel shaft, substantially as set forth.

2. The finger-keys *l* and electro-magnet *p*, connected as set forth, in combination with said type-wheel and the impression-lever, substantially as specified.

Signed by me this 18th day of April, 1872.

T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.

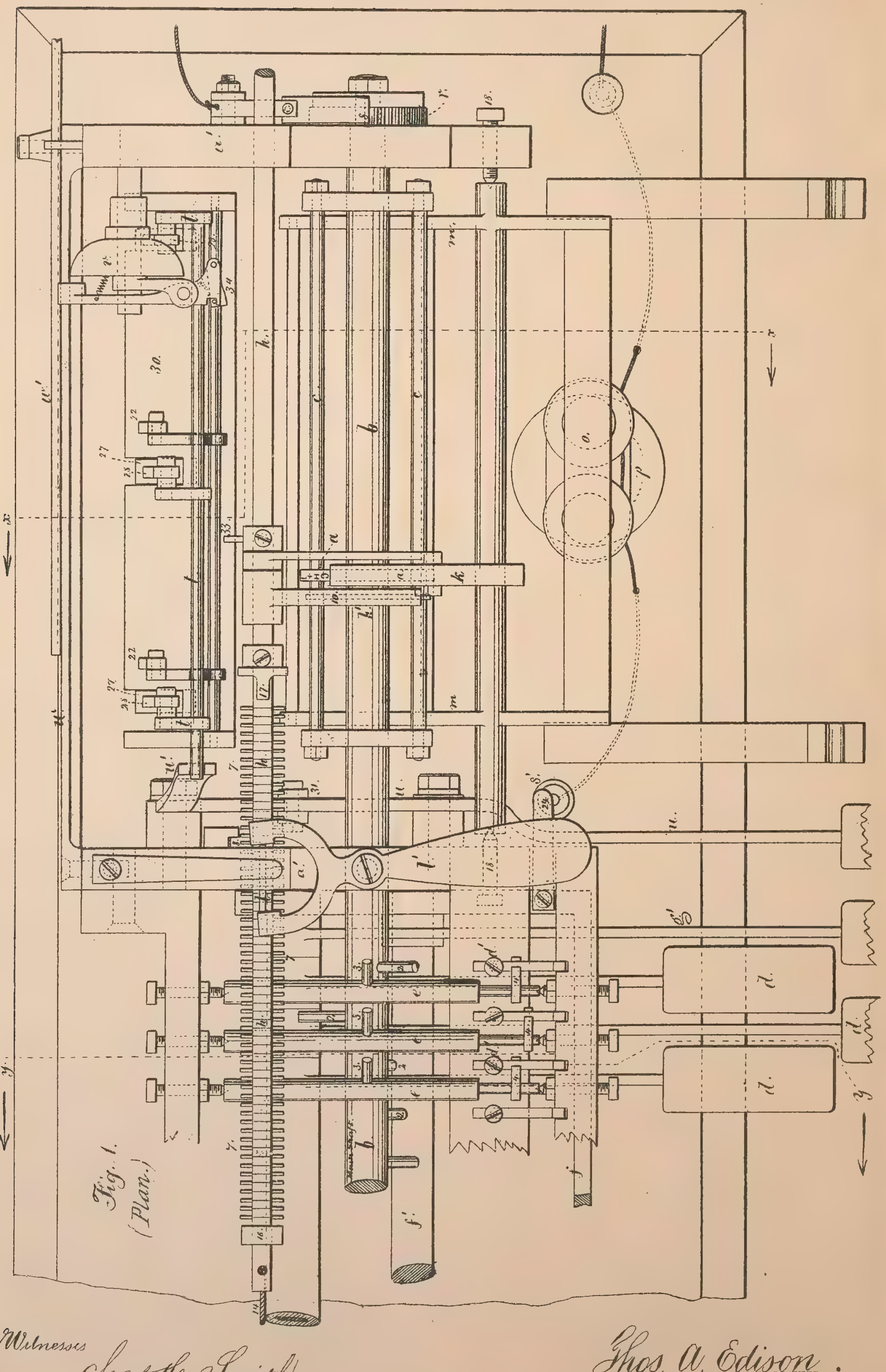


Fig. 1. (Plan.)

Witnesses
Chas H. Smith
Geo. D. Walker

Thos. A. Edison.
Lemuel W. Serrell
atty.

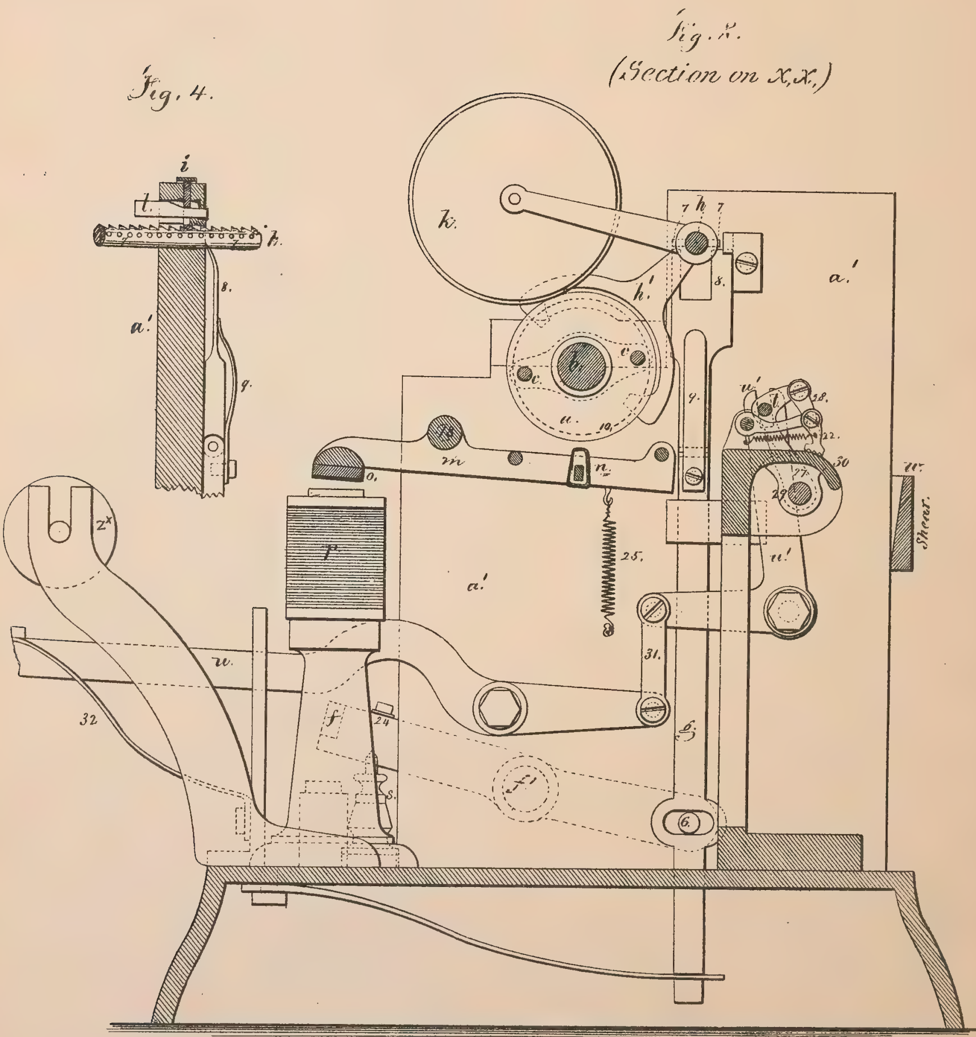
N. PETERS, Photo-Lithographer, Washington, D. C.

3 Sheets--Sheet 2.

T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.



Witnesses
Chas H. Smith
Geo. D. Walker

Thos. A. Edison.
Lemuel W. Serrell
atty.

3 Sheets--Sheet 3.

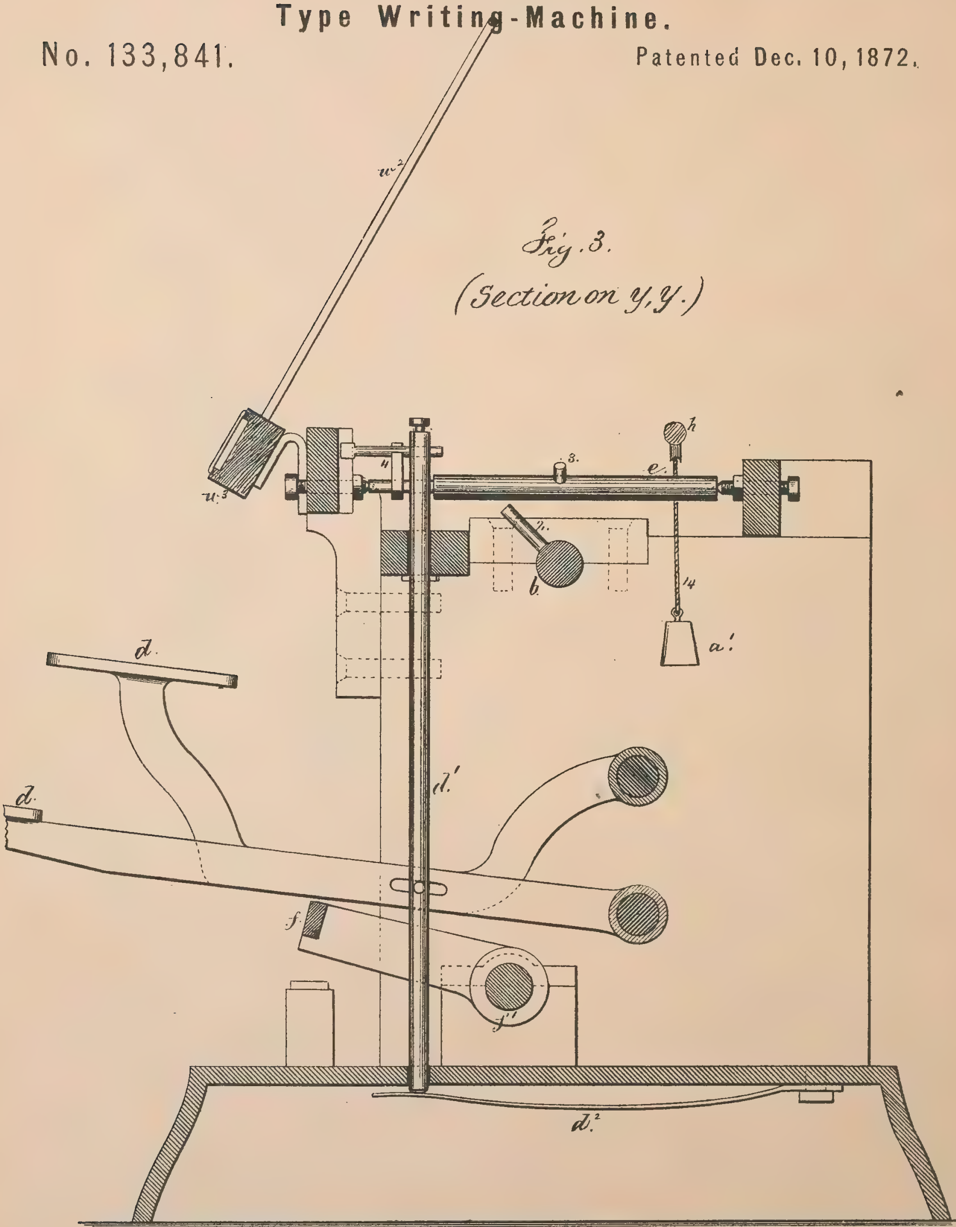
T. A. EDISON.

Type Writing-Machine.

No. 133,841. Patented Dec. 10, 1872.

Fig. 3.

(Section on y, y.)



Witnesses

Chas. C. Smith

Geo. D. Walker.

Thos. A. Edison.

Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TYPE-WRITING MACHINES.

Specification forming part of Letters Patent No. **133,841**, dated December 10, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented and made an Improvement in Printing-Machines; and the following is declared to be a correct description of the same.

This invention is for printing by a type-wheel in a line upon a sheet or web of paper and then moving such paper along so as to print upon the line below. This invention is divided into the following principal features: First, mechanism for arresting a revolving type-wheel with the designated letter in position to be printed; second, the means for moving the type-wheel along between one impression and the next; third, mechanism for bringing the type-wheel back from the end of one line so as to commence at the beginning of the next; fourth, the devices for impressing the paper on the type-wheel; fifth, the feeding devices that move the paper the distance between one line and the next.

By moving the type-wheel along the line and across the paper the parts are simplified and rendered more compact than in those machines in which the paper has been moved; hence a roll or web of paper can been employed, and a telegraphic message printed thereon by hand, and cut off, instead of writing out the same, as now usual.

In the drawings, Figure 1 is a plan of the operative parts of the machine and part of the keys. Fig. 2 is a section at the line *x x*, near the type-wheel. Fig. 3 is a section at the line *y y*, representing the keys.

The type-wheel *a* is upon a sleeve that can be slipped endwise upon the shaft *b*. The guide-rods *c c* that are secured to heads upon the shaft *b*, and are parallel to such shaft, pass through holes in the type-wheel, and serve to rotate the type-wheel, but they do not interfere with the movement of the type-wheel and its sleeve endwise of the shaft by the means hereinafter stated. The shaft *b* is of any desired length so as to pass over the range of finger-keys, and this range of finger-keys has the letters or characters corresponding to those on the type-wheel, and also the necessary keys for spaces between words and for moving the paper along from one line to the next. A pulley, continuously revolving by competent power, is applied to the shaft *b*, and an interposed friction allows the wheel to continue its revolution while the shaft and type-wheel are stopped. Upon the type-wheel shaft *b* are projecting pins or blocks 2, arranged spirally, or positioned so that when the stop-pin 3 is brought into the path of such block 2 the shaft *b* will be arrested by such pin 3, with the letter or character corresponding with the key depressed in position for printing.

The means for moving the pin 3 by the key might be varied; but I have shown the key *d* as acting upon a vertical bar, d', that has a pin acting in a cam-jaw, 4, upon the shaft *e* that carries such pin 3; hence, upon the depression of any one key, the pin 3 connected with that key will be moved into the path of the block 2 upon the shaft *b*, and properly stop the type-wheel.

Springs d^2 are employed for raising the keys, and the key will rise slightly without liberating the block 2, in order that there may be time for the paper to be drawn away from the type, as hereinafter described, before the type-wheel is again revolved. The finger-keys, for convenience, may be in two ranges, as shown. Beneath the range of finger-keys is a bar, *f*, supported by arms from the shaft f', so that when any one of the finger-keys is depressed the bar *f* will be moved, and, by the arm and pin 6, operate the feeding-bar *g*, which is made as a forked inclined pawl, 8, (see Figs. 2 and 4,) at the upper end, that is pressed between the spacing-pins 7 on the rack-bar *h*, and moves such rack-bar and the type-wheel along one space each time a key is depressed, and a spring, 9, allows this pawl 8 to yield as the bar *g* descends, and then springs back so as to take behind the next spacing-pin. (See Fig. 4.) The lever g' is placed above, as a finger-key, or connected with the bar *f* so that the pawl 8 can be operated to move the rack-bar and type-wheel between one word and the next without striking either of the letter-keys *d*. The rack-bar *h* is made to slide in the frames a' a', and is provided with a forked arm, h', that sets over the edges of a disk, 10, that is

connected with the type-wheel a, so that said type-wheel a will be free to revolve, but will be moved along upon the shaft b, as aforesaid, by the rack-bar h. This rack-bar h carries, also, the inking-roller or wheel k that supplies the necessary ink to the type. In the surface of the rack-bar h are notches, and a spring-pawl, i, is provided to take into these and hold the rack-bar as moved along by the pawl 8. (See detached view, Fig. 4.) At one end of the rack-bar h a cord or chain, 14, is attached, passing over a pulley to a weight, and this weight is sufficient to draw the rack-bar and type-wheel along when the pawl i is raised. As the type-wheel reaches the end of the line a projection, 16, on the rack-bar h slides a wedge, l, under the pawl i, lifting the same and allowing the weight to draw the rack-bar and type-wheel back to the commencement of the line, and as this movement is finished the projection 17 moves the wedge l away from the pawl i, allowing said pawl to become again operative. This wedge l can be operated by the hand-lever l' so as to return the type-wheel to the beginning of the line between one paragraph and the next. The device for giving the impression consists in a padded bar, n, beneath the type-wheel, and set in a frame, m, that is hung on centers 18, and carries the armature o of the electro-magnet p, and this electro-magnet gives the impression whenever the type-wheel is stopped by the depression of a key. The electrical connections for this magnet consist of a break-wheel, r, revolved with the type-wheel a, and having as many conducting and non-conducting spaces as there are spaces on the type-wheel, and the spring-tooth s rests upon the same, and is in the electric circuit. This circuit passes, also, through the magnet, as shown in Fig. 1, and to the insulated post s'; and upon the end of the bar f there is a spring-finger, 24, that touches the end of this post s' when the key is depressed; hence the circuit will be closed at this point, but the electro-magnet p will not become charged until the type-wheel stops, because the break-wheel r opens and closes the circuit too rapidly; but when the type-wheel stops, the tooth s being on one of the conductors of that break-wheel, the circuit remains closed long enough for the magnet p to act and give the impression. The shaft b and bed of the machine form part of the electric circuit to the spring-finger 24. The circuit will be broken at s' as the key rises and before the type-wheel is allowed to revolve, so that the spring 25 may draw away the impression-bar and paper and prevent the printing being blurred. A suitable stop limits the motion. The feeding device that moves the paper along from one line to the next consists in the spring-pawls 28, hinged to a frame, i, that swings on the shaft 29, and said pawls hold the paper against the swinging segments 27 in moving such paper, but draw over the surface in the backward movement, the paper being held at this time by the pawls 22 against the stationary table or shield 30. The key u, connection 31, and lever u' are used for moving the frame t and feeding the paper forward from the reel or drum z^*, and a spring, 32, returns the parts to their normal position. An alarm-bell, v, is employed to call the operator's attention to the line being finished, said bell being struck at the last or nearly the last movement of the rack-bar h, by a projection, 33, moving the tail of the hammer 34. The operator moves the paper forward at the proper time by depressing the key u; or it might be done automatically by a connection from the rack-bar as the type-wheel is drawn along. In order to cut off a piece of paper upon which the printing has been done I provide a stationary shear, w, and swinging shear w', the latter being kept open by a spring so as not to interfere with the paper as it is fed along. A rack or stand, w^2, should be supported above the finger-keys on the frames a' a', to hold the manuscript to be copied from, and a grooved bar, w^3, Fig. 3, may also be provided, in which a strip of paper may lie, this strip having upon it telegraphic characters in dots and dashes, either indented in the paper or made in colors in chemically-prepared paper, so that this may be drawn along in said bar as the message is printed.

I claim as my invention—

1. A type-wheel moved along in the line of its axis by a progressive movement between one impression and the next so as to print from such type-wheel in a line, substantially as set forth.

2. The rack-bar h and spacing-pins 7, in combination with the spring pawl 8, key d, and type-wheel a, substantially as set forth.

3. The pawl 8, in combination with the rack-bar h, disconnecting device i l, and stops 16 and 17 upon such rack-bar h, substantially as and for the purposes specified.

4. The lever l' and disconnecting device i l, in combination with the rack-bar h and type-wheel a, substantially as set forth.

5. A pressure-bar sustaining the paper to be impressed below the line of printing, in combination with a type-wheel moved endwise of the axis, progressively, between one impression and the next, substantially as specified.

6. The break-wheel r, spring-finger s, and electric circuit and circuit-breaker 24 s', in combination with the type-wheel, impression-bar, and electro-magnet, substantially as and for the purposes set forth.

7. The paper-feeding pawls 28, swinging with the segments 27 upon the shaft 29, in combination with the pawls 22 and stationary bed 30, as and for the purposes set forth.

8. A type-wheel and mechanism for moving

the same in the direction of its axis between one impression and the next, in combination with impression mechanism and with a paper-feed actuated between one line of printing and the next, substantially as specified, so that printing can be done line after line across a roll or web of paper, substantially as set forth.

Signed by me this 13th day of November, A. D. 1871.

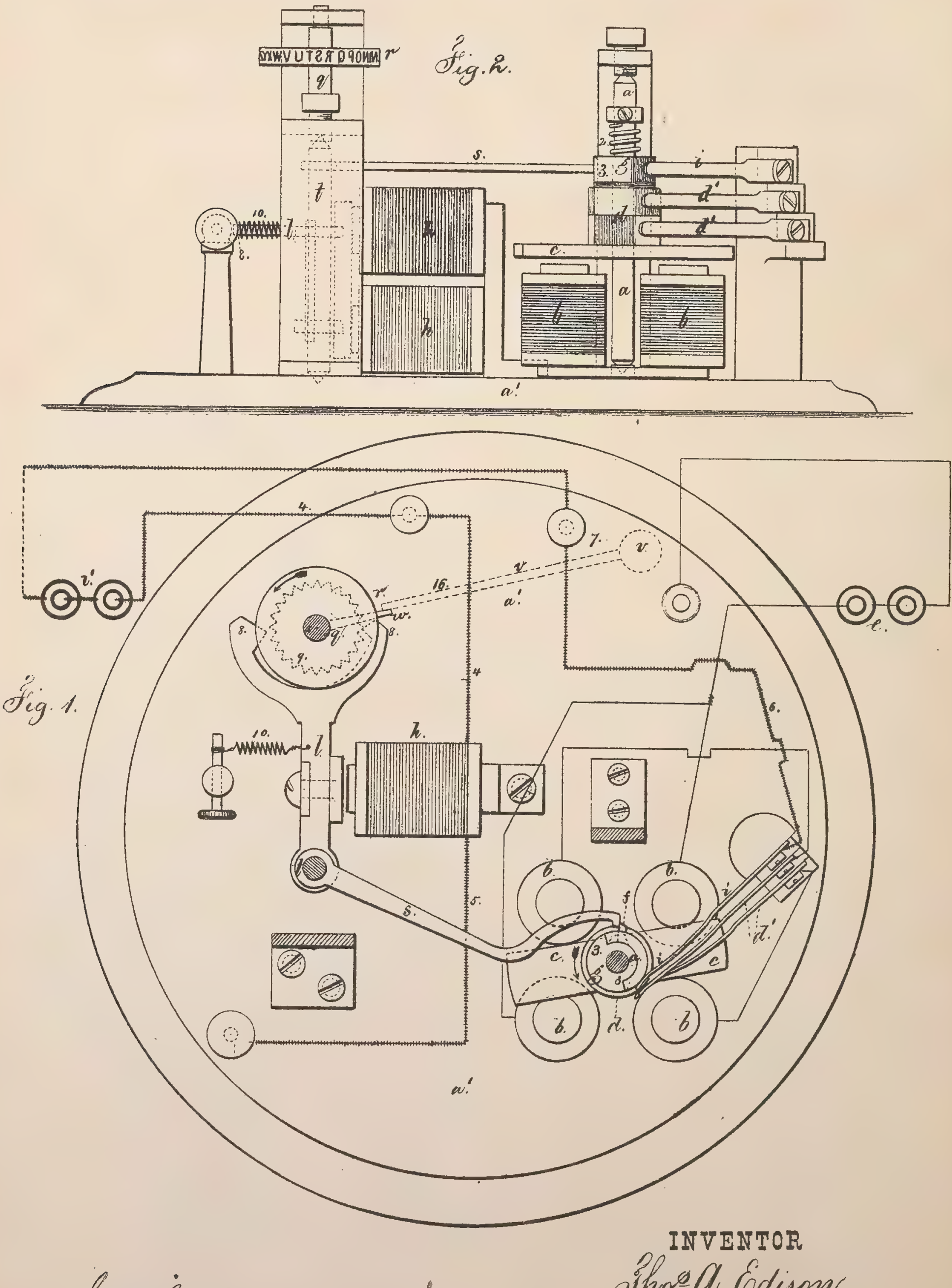
T. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Printing Telegraph Instruments.

No. 134,866. Patented Jan. 14, 1873.



INVENTOR

Thos. A. Edison

Chas H. Smith

Harold Serrell

Witnesses.

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **134,866**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Telegraph Instruments, of which the following is a specification:

This instrument is adapted to receiving and transmitting; and the transmitter is somewhat similar to that shown in Letters Patent granted to me January 23, 1872, No. 123,005, there being a pulsator upon a revolving shaft to open and close the main circuit as in said patent, and the pulsations operate through a magnet in the transmitter, and also in the receiving-machines to rotate their respective type-wheels by a step-by-step movement.

My present improvement relates only to the transmitting portion of the instrument; and the same consists of means for arresting the movement of the pulsator, when a finger-key is depressed for the purpose of breaking the circuit to the type-wheel magnets, and stopping the type-wheels at a letter corresponding with the depressed key.

I make use of a stop-arm vibrated by the type-wheel lever to arrest the movement of the pulsator, and this stop-arm is vibrated clear of a pin upon the pulsator each time the pulsator opens the circuit to the type-wheel magnets, while said circuit is being opened and closed to send pulsations to rotate the type-wheels; but when a finger-key is depressed to stop said type-wheels, this stop-arm is kept in the path of the pin and stops the pulsator with a circuit-closer upon its non-conducting portion, which breaks the circuit to the type-wheel magnets, and arrests all the type-wheels at the same point. When the key is liberated the type-wheel lever, by its spring, moves the stop-arm from the pin, and allows the pulsator to revolve with its shaft and open and close the main circuit, as before.

It is to be understood that in the receiving-machines this pulsator is stationary, the pulsations passing direct to the type-wheel magnets, energizing the same, and giving the step-by-step movement to rotate the type-wheels, and that the devices herein described are brought into action for transmitting from the machine sending the message.

In the drawing, Figure 1 is a sectional plan showing my improvements; and Fig. 2 is an elevation of the same.

The vertical shaft *a* is rotated continuously by the electro-motor, composed of the electro-magnets *b b*, armature *c*, circuit breakers and arms *d d'*, and connections to the battery *e*, all of which are of usual character. *g* is the pulsator, revolving by frictional contact with the shaft *a*, through the agency of the spring 2, and said pulsator is made with the conducting and non-conducting portions, as shown most clearly in Fig. 1; and *f* is a pin projecting from said non-conducting portion of *g*.

At each revolution of the pulsator *g* the circuit is opened and closed once to the type-wheel magnet *h*, the circuit being closed when the insulated arm *i* is in contact with the conducting portion 3 of the pulsator, and the pulsations pass by the wire 4 to said magnet *h*, and thence, by the wire 5, bed *a'*, shaft *a*, pulsator *g*, insulated arm *i*, and wire 6, to the insulated binder 7, to which the main-line wire is connected, and by this wire the pulsations pass to and through the type-wheel magnets of the receiving-machines at the distant stations, and return by the earth portion of the circuit. These pulsations act in the magnet *h* of the transmitter, and also in the same magnets of the receiving-machine, to rotate the type-wheels *r* by a step-by-step movement, by means of the lever *l*, pallets 8 8, and toothed wheel 9 upon the shaft *q*.

I will now describe how the pulsator is arrested in its movement to break the circuit to the type-wheel magnets and stop the type-wheels.

The finger-keys are in a semicircular range or ranges, as in aforesaid patent, and concentric with the shaft *q*; one of said keys is shown at *v* by dotted lines. *w* is an arm upon the shaft *q*. *s* is an arm upon the axis *t* of the lever *l*, and the outer end of said arm is contiguous to the pulsator *g* during each half revolution of said pulsator, when the circuit is closed to the type-wheel magnet *h*, and is moved away from the same by the back movement of the lever *l* during the other half revolution, when the circuit is broken to said magnet; hence said arm does not obstruct the movement of the pulsator while the circuit to the magnet *h* is being opened and closed to rotate the type-wheels. When a finger-key

is depressed its arm, 16, is brought in the path of the arm *w*, whose movement it arrests and stops the shaft *q*. The arm *w* is located with reference to the position of the teeth of 9, so that when said wheel is stopped it holds the lever *l* in the position shown in Fig. 1, with the stop-arm *s* in the path of the pin *f*, and said arm stops the pulsator with the circuit-closer *i* upon the non-conducting portion of the same, which breaks the circuit to the magnet *h*, and also to all the type-wheel magnets of the receiving-machines in the circuit, stopping their type-wheels at the same letter as the wheel *r*, and corresponding with the key depressed.

When the key is liberated the spring 10 completes the backward movement of the armature, type-wheel lever *l*, and pallets 8, giving a slight movement to the wheel 9, and also moving the stop-arm *s* sufficiently to liberate the pin *f* and allow the pulsator again to revolve with its shaft, and open and close the circuit to the type-wheel magnets, as before.

The printing lever and magnet are not shown in the drawing, but they may be of usual character, either for the transmitter or receiver, and be operated in any desired manner to effect the printing when the type-wheels are stopped.

I claim as my invention—

1. The stop-arm *s*, connected with the lever *l* and pallets 8, in combination with the pulsator *g*, and stop *f* for arresting the movement of the pulsator, substantially as set forth.

2. The type-wheel magnet *h*, in the circuit that is opened and closed by the pulsator *g*, in combination with a stop that arrests the movement of the pulsator when the circuit is broken, and a spring, or its equivalent, that liberates the pulsator upon completing the backward movement of the armature and pallets, substantially as set forth.

Signed by me this 16th day of October, 1872.

T. A. EDISON.

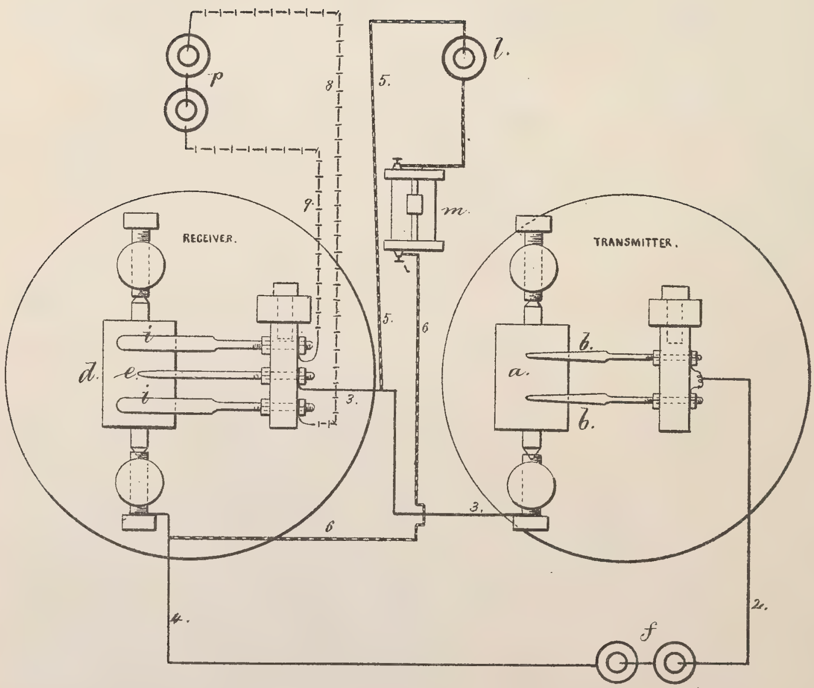
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Automatic Telegraph Instruments.

No. 134,867. Patented Jan. 14, 1873.



Witnesses,

Chas H. Smith

Geo. D. Walker

Inventor

Thos. A. Edison

L. W. Serrell atty.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPH INSTRUMENTS.

Specification forming part of Letters Patent No. **134,867**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs; and the following is declared to be a correct description of the same.

In chemical telegraphs difficulty arises in preventing the earth currents marking the paper and interfering with the sharpness of the dot and dash marks.

In my present invention I neutralize the earth currents, and also prevent the stylus being destroyed by the action of the acid in the chemical paper while the circuit is broken on the main line or the instrument is not in action.

I employ a rheostat to regulate the action of a battery that supplies a very feeble constant current to neutralize earth currents, and a local constant current is brought into contact with the surface of the chemical paper to pass across the paper near the stylus and prevent, by polarizing such paper, the action of the acids upon the iron stylus or pen, thereby preventing injury to the same during the time that the instrument is not in use.

The diagram in annexed drawing illustrates this invention.

The transmitting-roller *a* is mounted and rotated in any usual manner, and *b b* represent the transmitting stylus, brush, or spring roller or rollers. The receiving-roller *d* is propelled in any convenient manner, and the paper is drawn along in the ordinary way. The stylus *e* or marker is of iron or other material to make a mark upon the chemical paper when the electric current passes through such paper. The spring-conductors *i i* are of platinum, and rest upon the chemical paper at each side of the stylus *e*. The main battery *f* is connected, through the wire 2, stylus *b*, roller *a*, line-wire 3, to the stylus *e*; thence by the wire 4 or earth connection, so as to mark the paper as usual. The battery *l* is connected to the rheostat *m*, and by the wire 5 to the line 3 and the wire 6 to the earth line 4, so that a very feeble current, adjustable by *m*, is thrown on the line and earth connections in the reverse direction to the earth currents, so as to neutralize the same. The battery *p* is connected by the wires 8 and 9 with the spring-conductors *i i* so that a current will pass across the chemical paper resting upon the roller *d*. The main-line current from the stylus gives to the particles an electric condition; that condition continuing tends to prolong the mark after the pulsation ceases; the cross or counter current neutralizes this electric condition or polarity, and prevents attenuation of the mark; it also prevents injury to the stylus or pen by the action of the acids in the paper, because the current passing between the conductors *i i* is superior to any ground currents and neutralizes their action.

I claim as my invention—

1. The circuit from the battery *l* connected with the earth and line in a chemical telegraph instrument and adjusted by the rheostat *m* to neutralize earth currents, substantially as set forth.

2. The conductors *i i* connected with the battery *p*, in combination with the stylus *e* of a chemical receiving instrument, for the purposes and substantially as set forth.

Signed by me this 8th day of May, A. D. 1872.

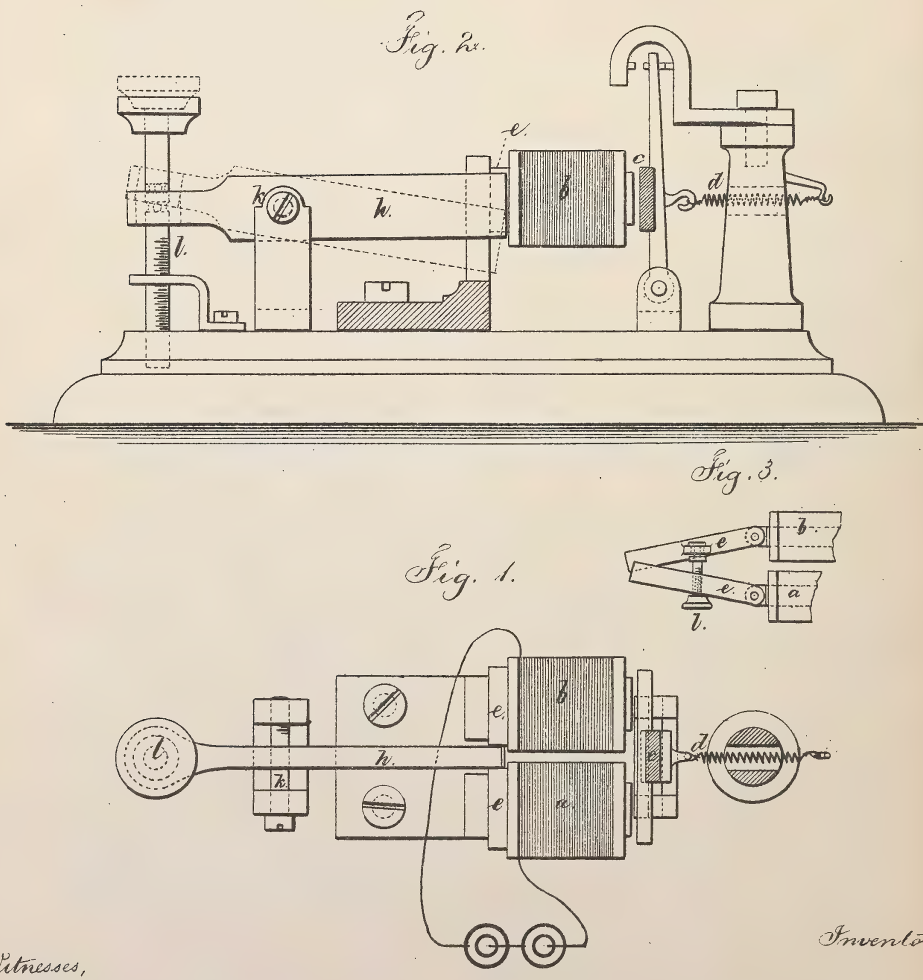
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Electro-Magnetic Adjuster.

No. 134,868. Patented Jan. 14, 1873.



Inventor

Witnesses,

Chas H Smith

Geo. D. Walker.

Thos. A. Edison

L. W. Serrell

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ELECTRO-MAGNETIC ADJUSTERS.

Specification forming part of Letters Patent No. **134,868**, dated January 14, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Electro-Magnetic Adjuster; and the following is declared to be a correct description of the same.

This invention is available with an electro-magnet made of two helices and cores, and is intended to vary the power of the electro-magnets without changing the intensity of the electric current, and thus rendering it unnecessary to adjust the spring that draws back the armature, because the power of the magnet itself is adjusted so as to maintain uniformity in the same, and, consequently, preserve the proper relations between the force of the spring and the power of the magnet.

I make use of a variable connection between the rear ends of the cores, and thereby vary the magnetic power of those cores. If the two cores are entirely separated, so that induced magnetism is checked, there will be but little power in the core, even when the helix is properly charged; but when the cores are connected by a proper iron bar the entire force of the magnetism is developed. I make use of these known features of magnetism to vary the power of the electro-magnet by lessening the conductor that unites the cores at their rear ends.

In the drawing, Figure 1 is a plan of a magnet with my improvement, and Fig. 2 is a side view of the same, partially in section.

The electro-magnets *a b* are made of helices around cores in the usual manner, and the armature *c* is hung on centers to vibrate as usual, and may be employed as a relay, or in any other electrical apparatus. The spring *d* exerts a uniform retractile force, and does not require to be adjusted for varying its power. The iron bar *e*, at the back end of the magnet, is united to the cores as usual, but instead of being continuous it is divided, and the adjuster *h* applied between the parts. This adjuster is shown as a lever upon a fulcrum, *k*, and moved by a set-screw, *l*, so that the end of the lever makes a full contact between the ends of the bars *e*, as shown by full lines, or only a partial contact, as illustrated by dotted lines in Fig. 2; and hence the power of the electro-magnet will be varied according to the position of the adjuster. The same effect is produced in the modification illustrated in Fig. 3, the bars *e e* being hinged to the cores and adjusted more or less into contact with each other by the screw *l*.

I claim as my invention—

The adjustable connection applied at the rear end of an electro-magnet, between the cores thereof, to vary the power of such electro-magnet, substantially as set forth.

Signed by me this 8th day of May, A. D. 1872.

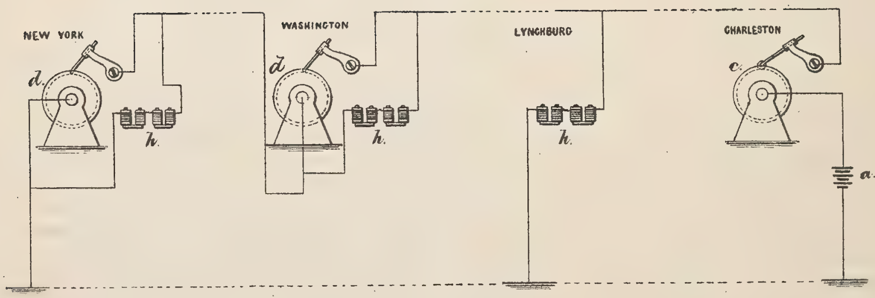
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Chemical Telegraphs.

No. 135,531. Patented Feb. 4, 1873.



Witnesses,
Geo. D. Walker.
Chas. H. Smith

Inventor
Thomas A. Edison,
Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **135,531**, dated February 4, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

Before this invention telegraphic circuits had been arranged with a rheostat to regulate the portion of the electric pulsation passing to the chemical paper, and allowing the other portions of the pulsation to pass along upon the main line, or to go to the earth as a leakage. In these cases the rheostat did not produce any counter current, and served only to direct portions of the electrical waves through the chemical paper, but the tailing and the attenuation of the mark was not avoided, and upon long lines these marks usually ran together, because there was not sufficient time for the electric action to cease, or the line to free itself before another pulsation succeeded and the line became surcharged. In all cases it has been desired to obtain the most perfect insulation of the line to avoid the use of powerful batteries and to lessen atmospheric influences. It has, however, been found that when the insulation is impaired by atmospheric influences, the marks upon the chemical paper are more distinct, because the surplus electricity finds vent in currents to the earth, lessening the tailing.

When an electro-magnet is charged by a pulsation the electric action, in the circuit of which the helix of the magnet forms a part, is augmented; but when the main or line current is broken the magnet, in discharging itself of the magnetism that has been induced, sets up momentarily a counter current or one of opposite polarity. I avail myself of these various conditions, and arrange the circuits in such a manner that the electro-magnets which are energized by the pulsation that makes the mark on the chemical paper, serve to intensify the electric action upon that paper; but that the counter current, set up when the primary circuit is broken, shall neutralize the tailing or attenuation of the current by the discharge of the magnetism from the electro-magnet, thereby allowing for the use of very feeble currents and rendering the marks upon the chemical paper sharp and clear; and I furthermore employ upon long lines one or more earth connections, in which are placed one or more electro-magnets, with or without rheostats to regulate the proportion of currents passing to the earth, such connections and electro-magnets serving to free the line from surplus electricity and by the reverse polar action, as the electro-magnet discharges itself, to free the line from any attenuation of the primary pulsations.

With long lines it is preferable to employ long electro-magnets; and the reverse, in order that the time occupied by the magnet in discharging its magnetism may be proportioned to the attenuation or tailing of the main current that is increased by the length of line.

In the diagram annexed I have illustrated my improvement by four stations, New York, Washington, Lynchburg, and Charleston. The message is being sent from Charleston to New York by the battery *a*, and any suitable transmitting instrument at *c*, such as a stylus and perforated paper, or a finger-key or other device. The battery may be connected with either the positive or the negative pole to the instrument, and the other to the earth wire. At New York is any suitable receiving instrument, at *d*, such as a drum and stylus, for the chemical paper. If intermediate connections are not required they may be dispensed with and the message will be received only at New York.

I provide a secondary or local circuit connected with the main circuit at both sides of the receiving instrument *d*, and in this I place the electro-magnets *h*. These and the others spoken of may be of ordinary character; but as quantity rather than intensity is required, large wires may be used for the helices, and solid bars, bundles, or tubes for the cores, and many of these may be employed, or a large number may be provided, and more or less may be brought into action by switches or a commutator. The helices might be of iron wire wound in several layers, and cores be dispensed with, the inner portions of the coils forming the electro-magnets.

When the circuit is closed and a pulsation passes in the main line, a local circuit will thereby be set up through the electro-magnets and connections in the same direction as that of the main-line, and thereby intensifying the

action upon the chemical paper, but as soon as the main-line circuit is broken the electro-magnets in discharging themselves set up a local circuit in the opposite direction through the stylus and chemical paper, neutralizing any tailing and causing the mark to be clear and distinct. The same effect is produced where the connections are arranged as at the station marked Washington, in order that a drop copy may be taken at that point.

At the station marked Lynchburg the electro-magnets *h* are placed in a branch or ground circuit, and the amount of the leakage regulated by the resistance of the magnets themselves, or of a rheostat, thereby conveying away, designedly, the proper portion of the current intermediately between the sending and the receiving station; and when the circuit of the main line is broken the electro-magnets set up a counter-current in the line as they discharge themselves, thereby freeing the line at one or more places, as circumstances require.

I claim as my invention—

One or more electro-magnets, arranged in a local or branch circuit, substantially as set forth, in combination with a chemical telegraphic receiving instrument, for the purposes set forth.

Signed by me this 9th day of November, 1872.

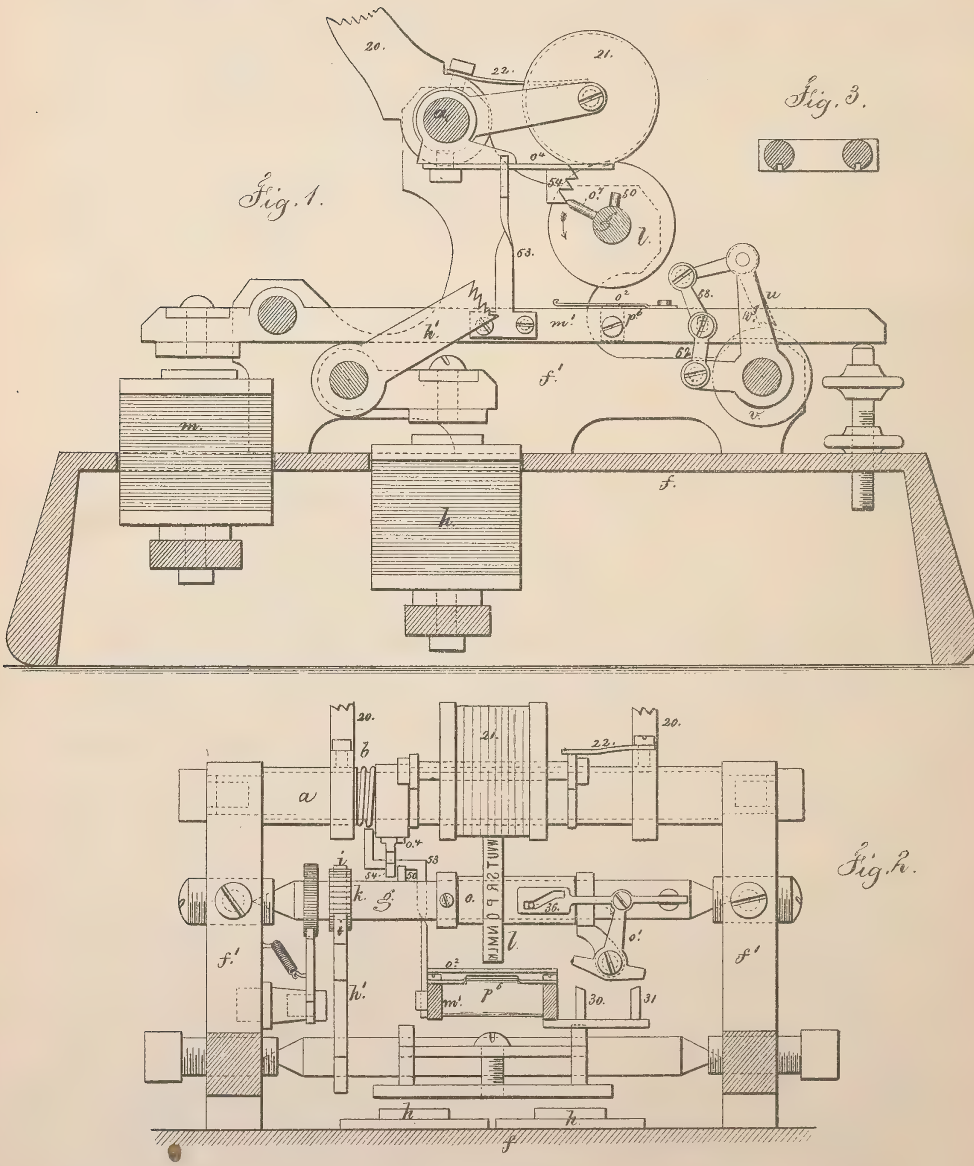
THOMAS A. EDISON.

Witnesses:
GEO. D. WALKER,
GEO. T. PINCKNEY.

T. A. EDISON.

Printing Telegraphs.

No. 138,869. Patented May 13, 1873.



Cha^s H. Smith

Harold Serrell

Witnesses.

INVENTOR

Tho^s A. Edison

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **138,869**, dated May 13, 1873; application filed October 22, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

This invention relates to modifications of and improvements upon the printing-telegraph machines heretofore patented by me. The features of improvement relate, first, to a unison mechanism that operates after two or more revolutions of the type-wheel, but is liberated and restored to a normal position each time the printing-lever is moved; second, to a peculiar paper-feeding mechanism that throws a tooth or pawl upon the paper, and then moves the same, and liberates the pawl from the paper before the return movement of the parts; third, to a means for partially rotating the type-wheel upon its axis to bring into position for use one set of characters, and throw out of use the alternate characters.

In the drawing, Figure 1 is a vertical section, and Fig. 2 is a partial front view, showing my present improvements.

The type-wheel magnet h acts through the armature and lever h' to set the type-wheel l, by a step-by-step movement given through the pallets i, escapement or ratchet wheel k, and shaft g. To insure greater rapidity in the discharge of the magnetism induced in the cores of the electro-magnet h, the said cores are grooved longitudinally, as shown in Fig. 3, which with a printing-telegraph is highly advantageous, because of greater rapidity, and avoiding the risk of inaccuracy arising from a sluggish backward motion in the armature. The inking-roller 21 is pressed toward the type-wheel l by the spring 22, upon the paper-reel arms 20, so that the sudden rotation of the type-wheel l will not swing said inking-roller away from contact with the types. This spring 22 can be turned aside when the inking-roller is to be lifted. Upon the shaft g is a tooth, o^7, that comes into contact successively with the teeth 54, and moves the arm o^4 down gradually until the end thereof is in the path of the stop 50, thereby arresting the type-wheel at a unison-point after the type-wheel has made two or more revolutions without the impression-lever m' being operated; but whenever the impression-lever is moved, the arm o^4 is raised by the finger 53 acting beneath it. In this manner the unison is prevented from coming into action except when the type-wheels are rotated with special reference to bringing a number into unison. The finger o^4 is sustained by a sleeve around the cross-bar a, and there is a spring, b, to apply the required friction to hold the parts in the position to which they are moved. The type-wheel l is upon a sleeve, o, surrounding the shaft g. The cam-bar 36 is sustained in guides upon the shaft g, and can be moved endwise by the T-lever o^1; and the shape of the cam 36 is such that it acts upon the sleeve o and type-wheel, to turn the same the extent of the distance from one character to the next; hence, where the step-by-step motion turns the type-wheel the distance occupied by two characters (for rapidity) the aforesaid cam 36 will bring into action one set of characters and throw out of action the other set of characters placed alternately around the type-wheel. The movement is given endwise to the cam 36 by the pin 30 or 31, upon the printing-lever coming into contact with the T-lever o^1, when the type-wheel is rotated around to the proper point for bringing such lever o^1 over the pin 30 or 31, after which the printing-lever is moved. The feeding-pawl u is upon an arm, v', and its lever is connected by a link, 68, to the printing-lever m', and the arm v', is connected also to m', but by a slotted link, so that as the lever m' rises, the strip of paper is first seized between the roughened end of u and the roller v; then the link 62 swings all the parts together. On the return movement the slot in 62 allows the pawl u to be lifted off the paper before the arm v' is swung back by the link 62.

I claim as my invention—

1. The tooth o^7 and stop 50 upon the shaft g, in combination with the arm o^4, teeth 54, and finger 53, moved by the printing-lever m', the parts being arranged and operated substantially as set forth.

2. The pawl u upon the arm v', and con-

nected by the link 68 with the lever m', in combination with the slotted link 62, that swings the lever v' to feed the paper, substantially as specified.

3. The cam 36 moved by the T-lever o^1 and pins 30 31 upon the printing-lever, in combination with the type-wheel l and sleeve o, substantially as and for the purposes set forth.

Signed by me this 16th day of October, A. D. 1872.

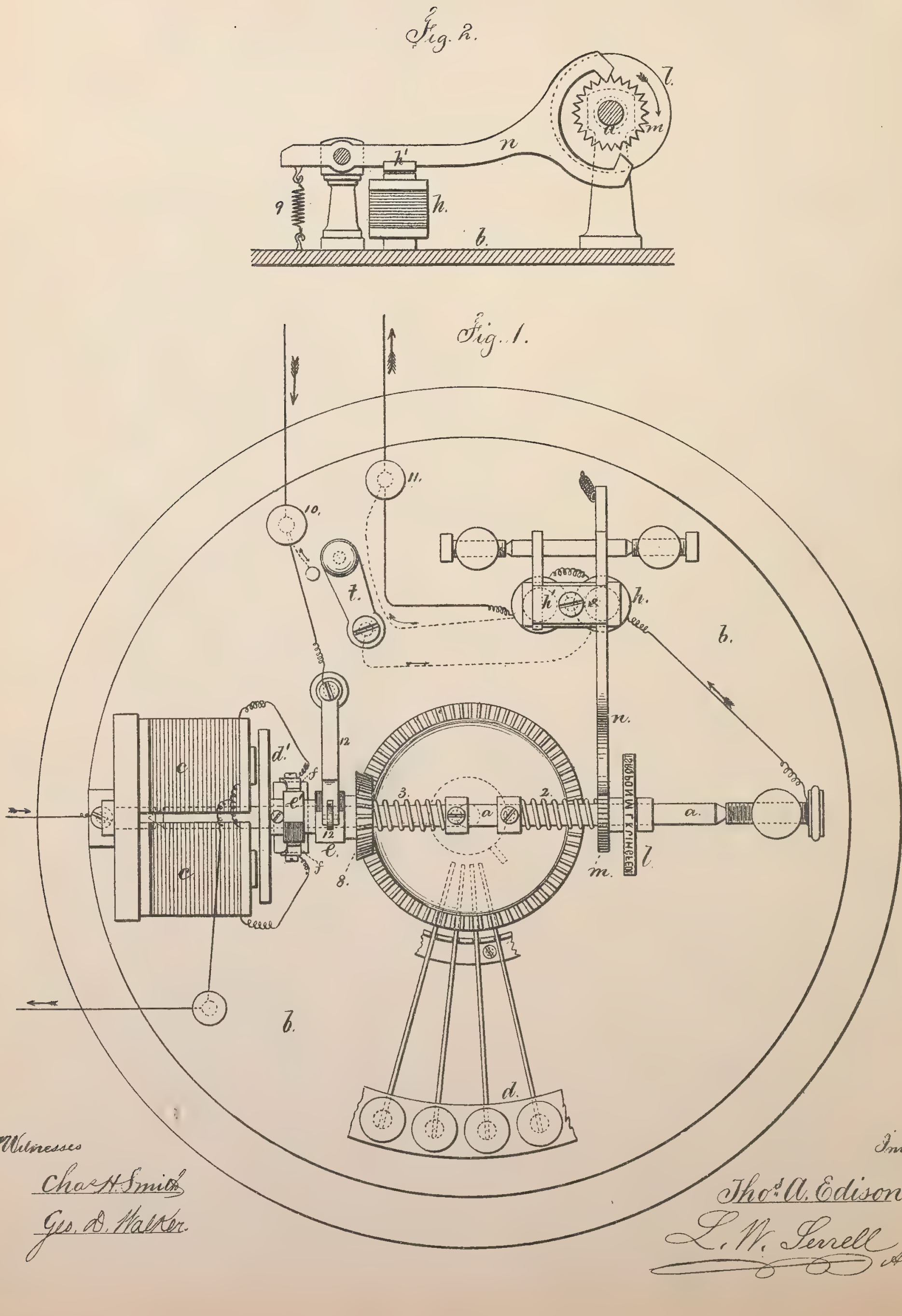
T. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraphs.

No. 138,870. Patented May 13, 1873.



Witnesses

Chas H. Smith

Geo. D. Walker

Inventor

Thos A. Edison

L. W. Serrell Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH CO., OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **138,870**, dated May 13, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments, of which the following is a specification:

This instrument is a combined transmitter and receiver, and the pulsator (which opens and closes the circuit to the type-wheel magnets) and the type-wheel are upon the same shaft, and this shaft is revolved continuously by an electro-motor or other device.

The pulsator and type-wheel are both revolved by frictional contact with their shaft; but the type-wheel only moves with said shaft as the pallets of the type-wheel lever allow the escapement-wheel that is connected to the type-wheel to turn by a step-by-step movement. This lever is vibrated by its magnet and spring each time the pulsator opens and closes the circuit to said magnet; hence said type-wheel is moved by the step-by-step escapement each pulsation of electricity.

In the drawing, Figure 1 is a plan of my improved instrument, and Fig. 2 is an elevation of the type-wheel magnets, levers, and escapement.

The shaft *a* is supported in suitable supports or standards on the bed *b*, and is revolved continuously by the electro-motor, composed of the electro-magnets *c c*, revolving armature *d′*, circuit-breaker *e′*, contact-springs *f f*, and connections to a local battery, all of usual character; and it is to be understood that the shafts *a* of the distant receiving-instruments are each revolved by an electro-motor or other device, and about in unison with the shaft of the transmitter. *e* is the pulsator, and 12 its contact-roller for opening and closing the circuit to the type-wheel magnets *h*, and said pulsator revolves with the shaft *a* by friction of the spring 3.

The operation of this pulsator in opening and closing the circuit to said magnets *h* is the same as that set forth in Letters Patent No. 131,343 granted to me, and the means for stopping the pulsator and impressing from the type-wheel *l* are substantially the same as in said patent, the pulsator being arrested when a finger-key, *d*, is depressed and its arm brought in the path of a stop upon a shaft connected by gearing to a pinion, 8, that moves with the pulsator. The type-wheel *l* and its escapement-wheel *m* are upon a sleeve or otherwise connected, and they are upon said shaft *a* and move with it by friction through the spring 2 when permitted by the type-wheel lever *n*. The pulsations from *e* through the main line and magnets *h* at the distant stations vibrate the armatures *h′* and levers *n* in unison, letting off the teeth of the escapement-wheels and allowing the shafts *a* to revolve the type-wheels by a step-by-step motion.

The connections for the transmitter are shown by full lines in Fig. 1, the current entering by the binder 10 and passing through the pulsator *e*, shaft *a*, and magnets *h*, and by the binder 11 to the line and the distant receiving-instruments. Each instrument is provided with a switch at *t*, and the connections for the distant receiving-machines are shown by dotted lines in same figure.

The mechanism for impressing the letter and printing, when the type-wheels are stopped, may be of any desired character, and do not form part of this invention.

I claim as my invention—

The type-wheel and pulsator both upon the same shaft and revolved by friction, in combination with the type-wheel lever, escapement, and electro-magnet, substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraphs.

No. 139,128. Patented May 20, 1873.

Fig. 2.

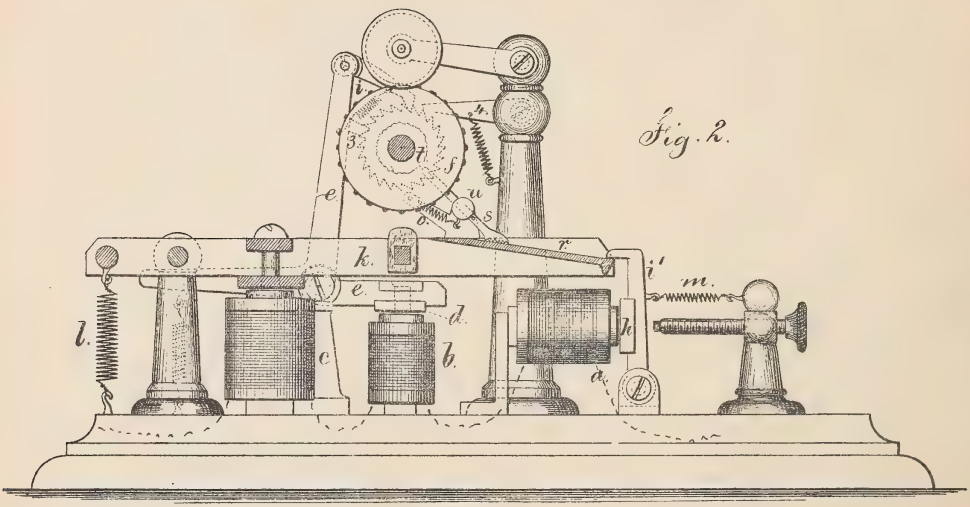
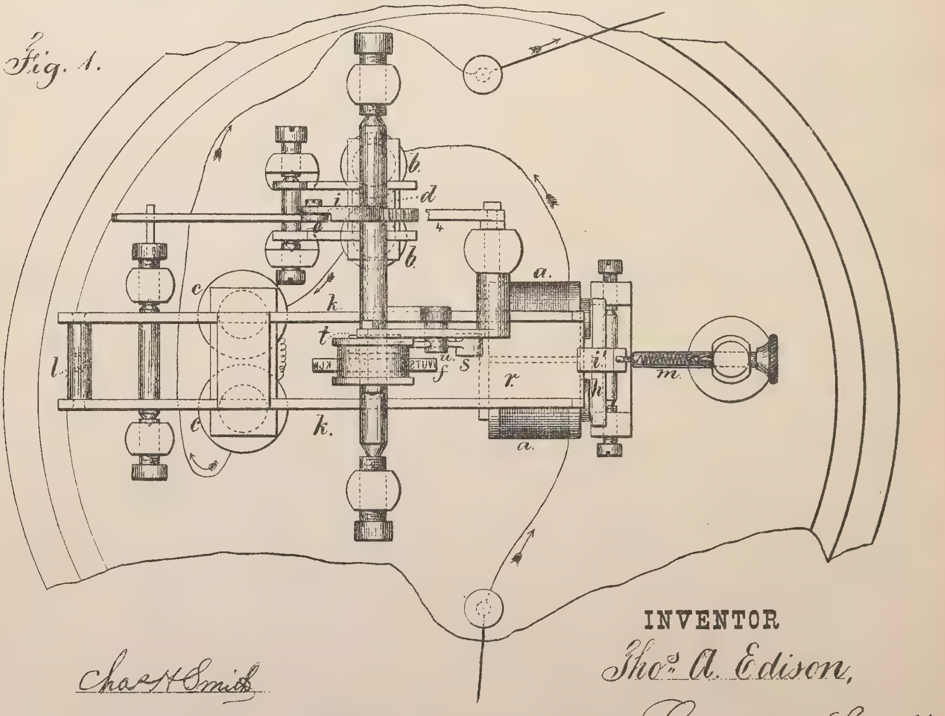


Fig. 1.



Chas H Smith

Geo D. Walker

Witnesses.

INVENTOR

Thos. A. Edison,

Per. Lemuel W. Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **139,128**, dated May 20, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraph Instruments, of which the following is a specification:

In this instrument there are three electro-magnets, all in the main-line circuit, and they are so adjusted that the pulsations act in one of the magnets to set the type-wheel; but the other two magnets, discharging more slowly, act to hold down the printing-lever. When the circuit is broken and a pause ensues the electro-magets all discharge, allowing a spring to the armature of one to draw back a hook and allow the printing-lever to fly up by a spring. The next pulsation energizes all the magnets, drawing down the printing-lever and holding it; then the other pulsations set the type-wheel.

In the drawing, Figure 1 is a plan representing the improvement, and Fig. 2 is a side view of the instrument.

The magnets *a b c* are in the main-line circuit, as seen in Fig. 1, so that the pulsations energize all the magnets; the magnet *b*, however, is small, and so made as to rapidly discharge; hence the pulsations act to move the armature *d*, lever *e*, and pawl *i*, and set the type-wheel *f*. I remark that the dog 3, shown by dotted lines in Fig. 2, blocks the ratchet-wheel to prevent it turning too far by the inertia, and the pawl 4 prevents motion in the wrong direction. The magnet *a* acts upon the armature *h* and hook *i′* to hold down the printing-lever *k*, and the magnet *c* is sufficiently powerful to draw down that lever *k* against the action of the spring *l*.

When the circuit is broken and a pause ensues the magnets *a c* discharge themselves, and the spring *m* draws back the hook *i′*, allowing the spring *l* to throw up the printing-lever *k* and give the impression. When a pulsation is sent again the three magnets *a b c* are energized, the printing-lever is drawn down by *c* and latched by the hook *i′* until another pause on an open circuit occurs. The strip of paper passes between a sliding pawl, *s*, and a plate, *r*, upon the printing-lever, and this pawl *s* slides in a turning-stud, *u*, that is drawn back by a spring, *o*. Upon the shaft of the type-wheel *f* is a snail-wheel, *t*, shown by dotted lines in Fig. 2, the periphery of which is notched, of different distances from the center of the shaft, in accordance with the distance the paper is required to be fed for the letter impressed. As the printing-lever *k* rises, the end of the sliding pawl *s* comes into contact with this snail-wheel, and the other end, clamping the paper, slides it upon the incline or surface *r* until the printing is effected. At the reverse movement the spring *o* draws the sliding pawl back to the normal position.

I claim as my invention—

1. Three magnets in the main-line circuit, operating as set forth, in combination with the type-wheel lever, printing-lever *k*, spring *l*, and latch *i′*, substantially as and for the purposes set forth.

2. The sliding pawl *s*, in combination with the snail-wheel upon the type-wheel shaft, and the printing lever *k*, substantially as set forth, for feeding the paper.

3. A printing-lever and an electro-magnet arranged in connection with the type-wheel and its magnet, substantially as set forth, so that the printing-lever is drawn away from the type-wheel by the electro-magnet, and the printing is effected by breaking the circuit to the electro-magnet.

Signed by me this 21st day of January, A. D. 1873.

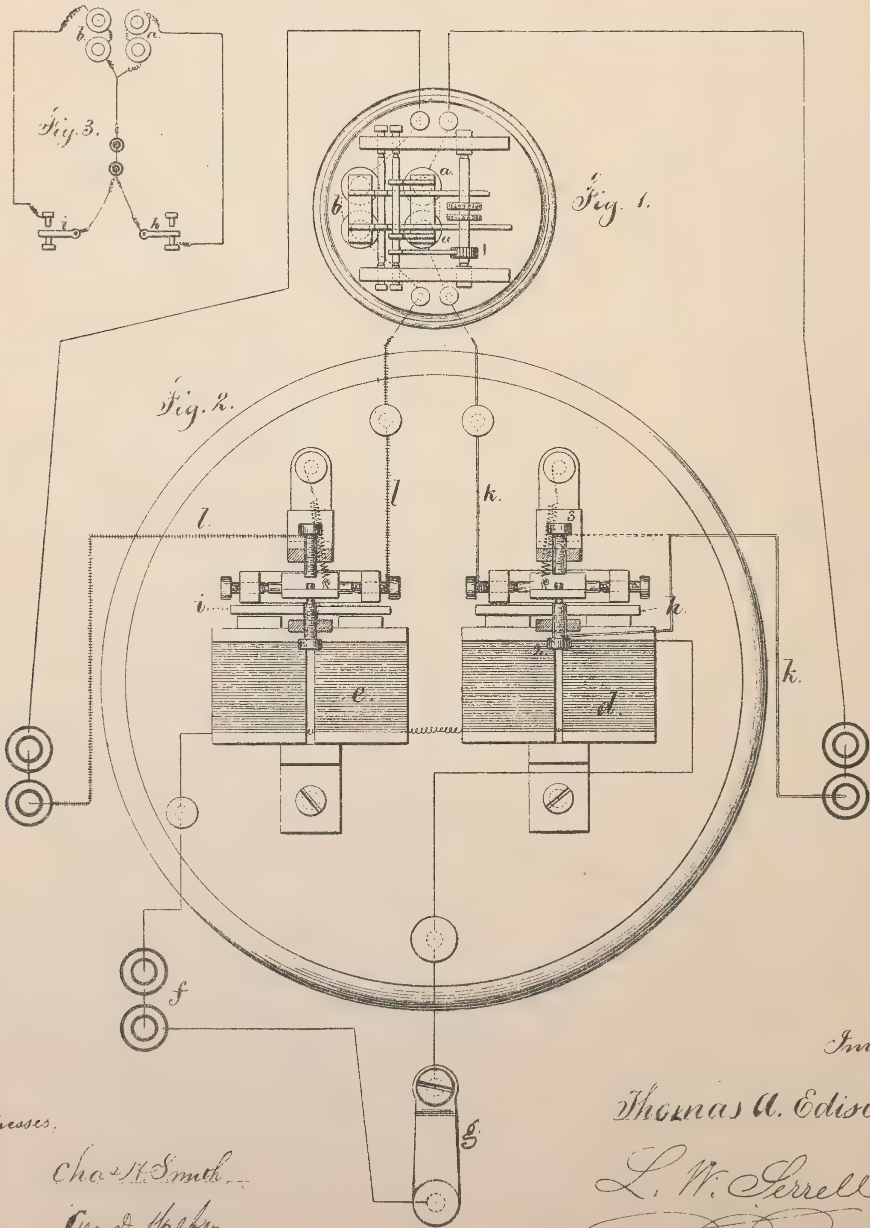
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing Telegraphs.

No. 139,129. Patented May 20, 1873.



Witnesses.

Chas. H. Smith

Geo. D. Walker

Inventor

Thomas A. Edison.

L. W. Serrell atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **139,129**, dated May 20, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Transmitting-Instruments for Printing-Telegraphs, of which the following is a specification:

In this instrument there are two electro-magnets in a main-line circuit, in which, also, is the key or other instrument for opening and closing the circuit. The relay-magnets are provided with armatures and circuit-closers, and the retractile springs of the armatures are of different tensions, so that the relay, working a local circuit through the type-wheel magnet of the printing-instrument, energizes the same each pulsation in the main line. The local circuit of the printing-magnet remains broken, because the armature of that relay-magnet is kept toward the magnet by the residual magnetism until a pause in the transmission occurs sufficient to allow the printing relay-armature to recede and close the relay circuit to the printing-magnets. In this manner it is only necessary to pulsate the main-line circuit and pause to effect the printing when the type-wheel has been set.

In the drawing, Figure 1 shows a printing-telegraph instrument of any desired character, *a* representing the type-wheel magnet, and *b* the printing-magnet. Fig. 2 is a plan of the relay-instrument.

The magnets *d* and *e* are in the main-line circuit from the battery *f*, and *g* is a finger-key or other closer at the distant station to pulsate the current through *d e*. The armatures *h* and *i* are drawn back by springs of different tension, the spring of *h* being the most powerful, so that the armature *h* will respond to each pulsation of *g*, and close and open the local circuit *k* to the type-wheel magnet *a* in the various printing-instruments; thereby the type-wheels will be set by such pulsations. During these pulsations the armature *i* will be held toward the electro-magnet *e*, because of the residual magnetism and slight tension of the retractile spring of the armature; but when a pause occurs the magnet *e* discharges itself, the armature *i* is drawn away, and the relay circuit *l* closed to the printing-magnets *b*, so as to give the impression. If the printing is to be effected when the local circuit *k* is closed, the connection will be made to the screw 3 instead of the screw 2. With circuits arranged as in the diagram, Fig. 3, only one local battery will be required, the connections and operations corresponding with those before described. The magnet *d* may be used for setting the type-wheel by direct action of the armature on pallets, and the armature of the magnet *e* be used to close the local circuit to the printing-magnet *b*, as before.

I claim as my invention—

1. Two relay-magnets in the main circuit, with retractile springs to the armatures of different tensions, in combination with relay circuits to the type-wheel and printing electro-magnets, respectively, of a printing-telegraph instrument, substantially as and for the purposes set forth.

2. Two relay-magnets in the main circuit, with armatures adjusted differently, in combination with a local circuit effecting distinct and different operations, according to the length of pause between pulsations in the main line, substantially as specified.

Signed this 13th day of February, A.D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

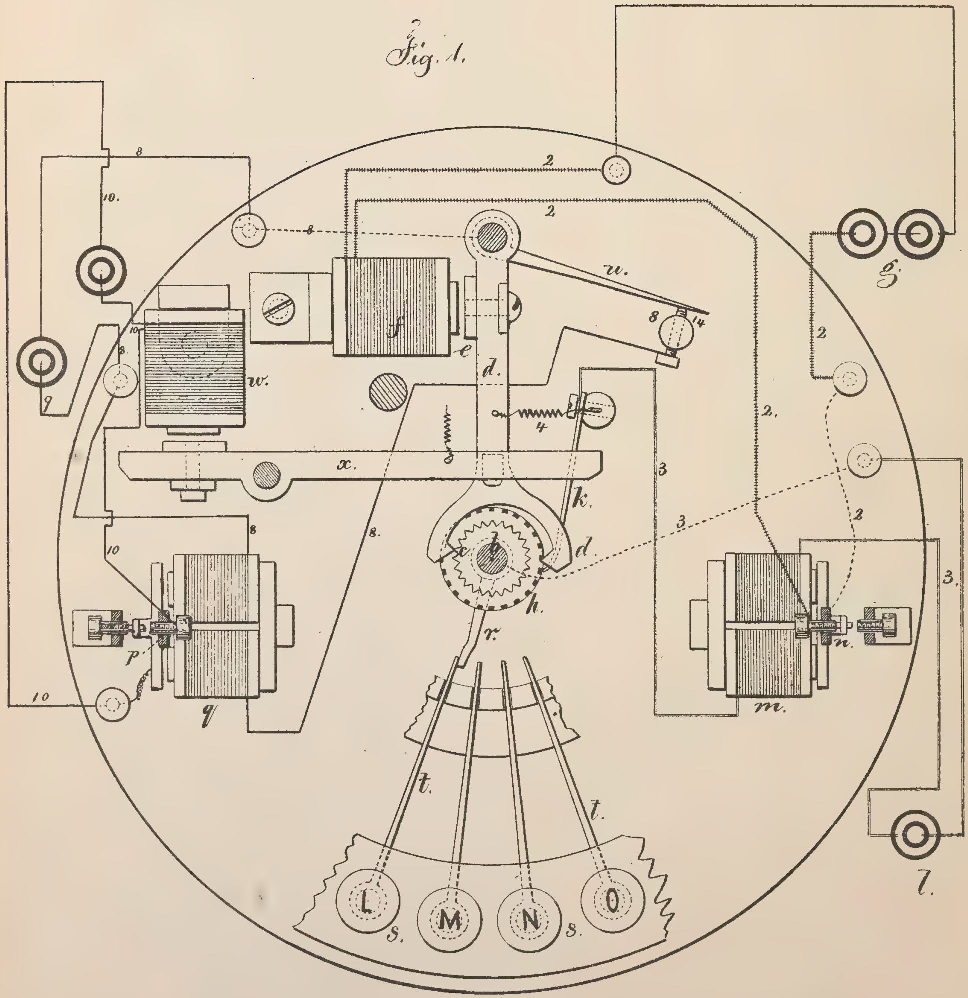
2 Sheets--Sheet 1.

T. A. EDISON.

Printing Telegraphs.

No. 140,487. Patented July 1, 1873.

Fig. 1.



Chas H. Smith

Geo. D. Walker

Witnesses.

INVENTOR

Thomas A. Edison

Per. L. W. Serrell

ATTY.

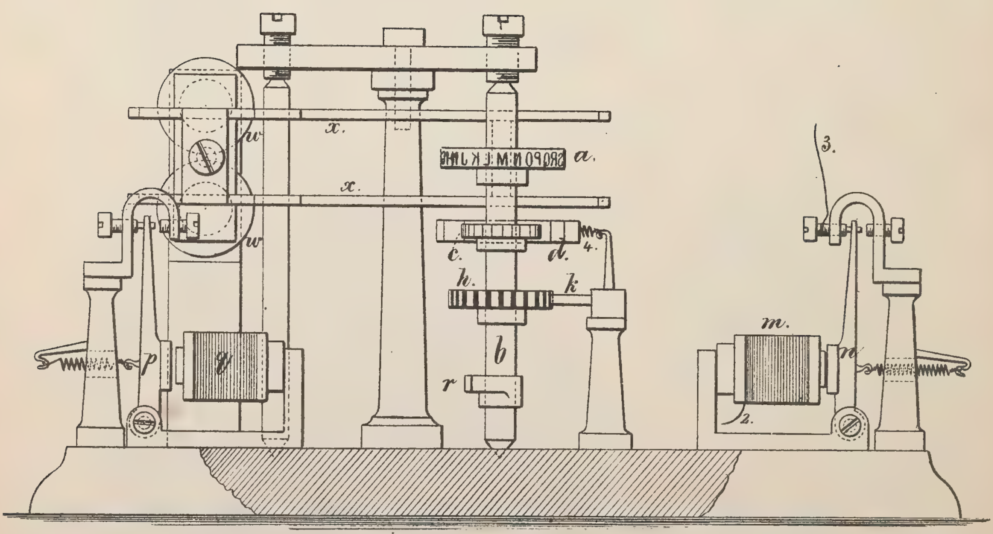
2 Sheets--Sheet 2

T. A. EDISON.

Printing Telegraphs.

No. 140,487. Patented July 1, 1873.

Fig. 2.



Chas H Smith

Geo. D. Walker

Witnesses.

INVENTOR

Thomas A. Edison,

Per L W Serrell

ATTY.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,487**, dated July 1, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Printing-Telegraphs, of which the following is a specification:

In this improvement the transmission is effected by pulsations through a break-wheel, relay-magnet, and main line; and as the pulsation energizes the relay-magnet it closes a local circuit to a type-wheel magnet that acts upon pallets to rotate the type-wheel and the break-wheel, and in so doing breaks the main-line circuit, and allows the main line to break the local, and the spring of the type-wheel armature to draw the latter back, and by the pallets move the type-wheel and break-wheel around further, and reclose the main circuit, and repeat the operations before described. These connections are resorted to to prevent too rapid movement. The main-line pulsations act in all the instruments of the line to set the type-wheels through the local circuits. The transmitting-instrument is stopped at a point when both circuits are broken, and in each receiving-instrument the pallet-lever, being drawn back by a spring, closes a local circuit to a magnet that operates the printing-circuit and energizes the printing-magnet.

In the drawing, Figure 1 is a plan representing portions of the instrument and the circuit-connections, and Fig. 2 is a side view of part of the instrument.

The type-wheel *a* is upon a shaft, *b*, that has a pallet-wheel, *c*, operated by a pallet-lever, *d*, the armature *e* of which is moved by the magnet *f*, that is in the circuit 2 2, from the battery *g*. A break-wheel, *h*, upon the shaft *b*, and a contact-spring, *k*, of suitable construction, are in the circuit 3 from the battery *l*, in which circuit is the relay-magnet *m*, the lever *n* of which opens and closes the circuit 2.

The operation of these parts is, that when *m* is energized the lever *n* closes the circuit 2; this energizes the type-wheel magnets *f*, and by the pallet-lever *d* the type-wheel is moved half a space. This at the transmitting-instrument breaks the circuit 3 by one of the non-conducting segments of the wheel *h* coming under the end of *k*. The circuit 3 being broken, the lever *n* falls back, breaking the circuit 2, and the magnets *m f*, discharging, allow the spring 4 to draw back the pallet-lever *d*, moving the break-wheel *h* far enough to close the circuit 3 again, and the operations are repeated, thus producing an automatic opening and closing of the circuits 2 and 3, and the speed of movement can be regulated by the tension of the armature-springs.

If the circuit 3 is the main line, then the circuit 2 will be local at the transmitting and receiving stations; but if the circuit 3 is local the circuit 2 may be the main line, and the circuit 3 will not be in use while receiving.

If a finger-key is depressed the arm *r* upon the shaft *b* is arrested by the lever *t* of the finger-key *s*, (a few only of these keys are shown, but they are of usual character,) and the parts are in the position shown; but both circuits 2 and 3 are broken, and the spring *u* closes the circuit 8 from the battery 9 to the local magnet *q*, the armature-lever *p* of which closes the printing-circuit 10, that passes through the printing-lever magnets *w*, so that a pause at the transmitting-instrument allows time for the energizing of the respective magnets *w* and the printing of the letter by the levers *x*.

The printing may be effected with one local circuit, if the spring *u* forms part of the circuit 10; and in cases where these instruments are used with two line wires the line-wire forms part of the circuit 10 to the printing-magnet of the distant instrument or instruments. As the finger-key is raised the spring 4 draws the pallet-lever *d*, and turns the wheel *h* sufficiently to close the circuit 3, and the pulsations are set up as before. The time that the spring *u* is in contact with the circuit-screw 14 is momentary, except when there is a pause by depressing one of the keys; hence the printing-magnets will only be energized at that time.

I claim as my invention—

1. The combination of the type-wheel, pallet-wheel, circuit-wheel *h*, and pallets with the circuits 2 and 3 and electro-magnets *m* and *f*,

substantially as set forth, for automatically opening and closing the respective circuits and rotating the type-wheels, as set forth.

2. The printing-circuit closed by the spring u of the pallet-lever when the circuits 2 and 3 are broken, and the movement of the type-wheel arrested by the depression of a finger-key, in combination with the pallets that are moved by the spring and close the type-wheel circuit when the finger-key is released, substantially as set forth.

Signed by me this 13th day of February, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

3 Sheets--Sheet 1.

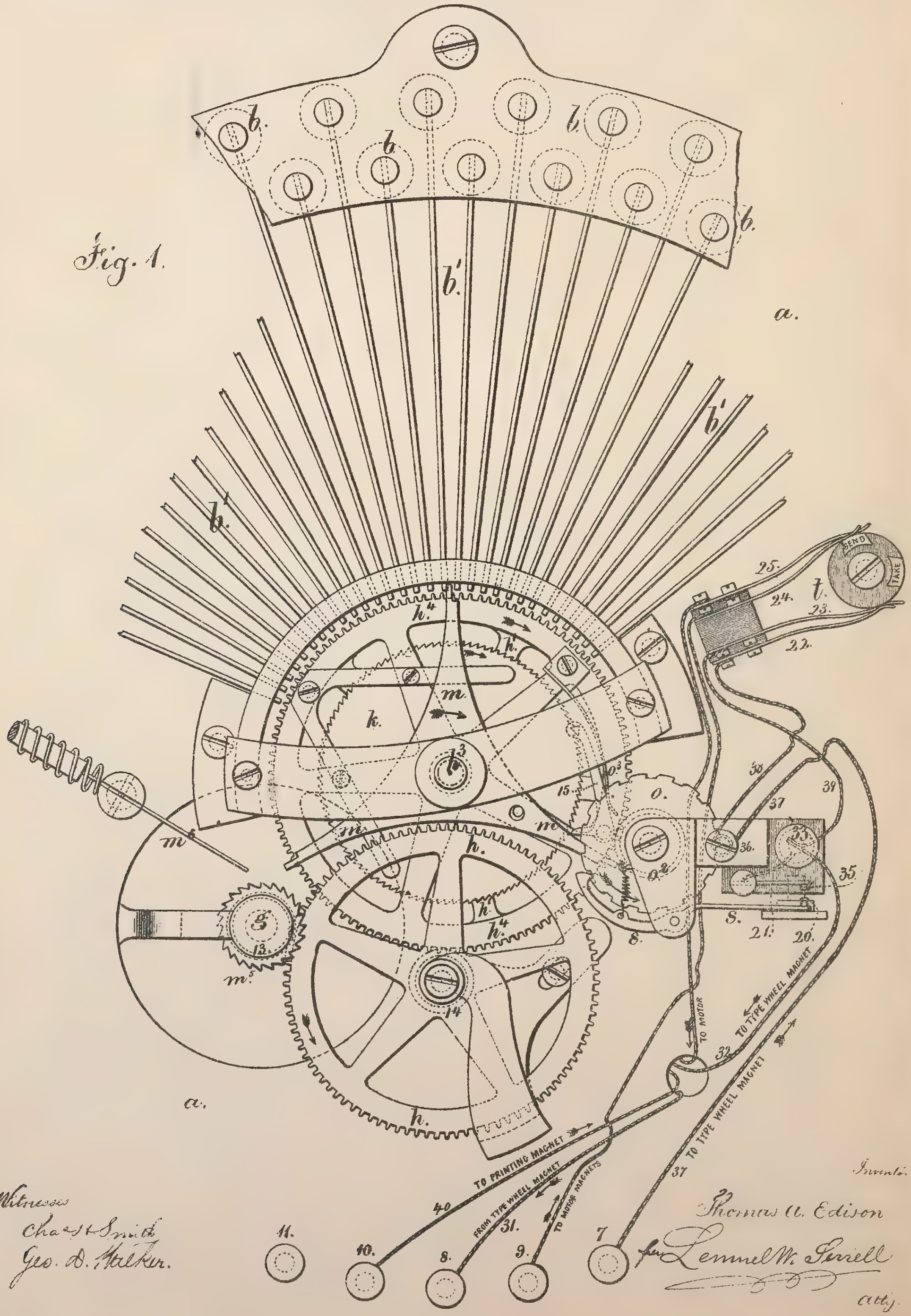
T. A. EDISON.

Printing Telegraphs.

No. 140,488.

Patented July 1, 1873.

Fig. 1.



Witnesses

Chas. H. Smith

Geo. D. Walker.

Inventor

Thomas A. Edison

per Lemuel W. Serrell

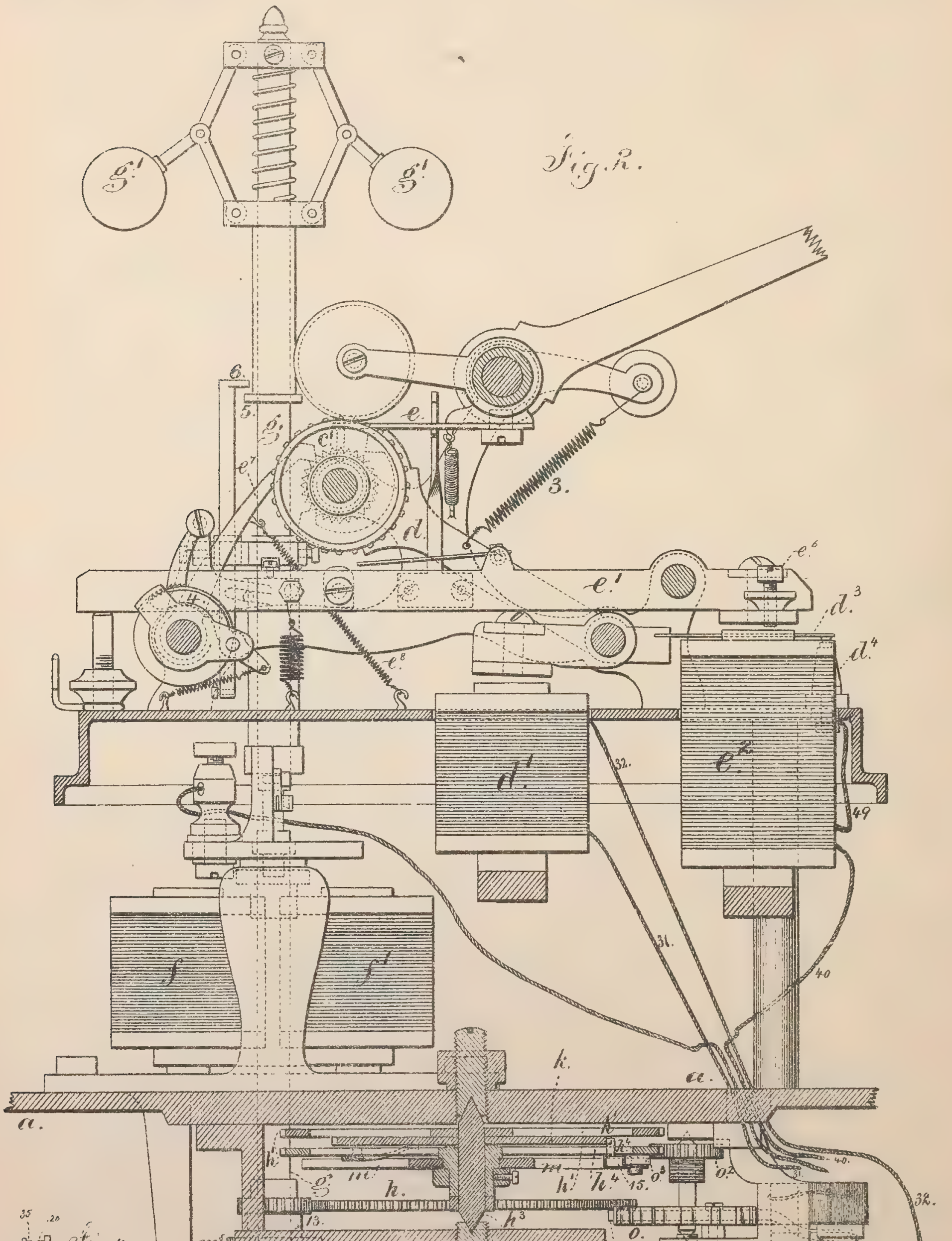
Atty.

3 Sheets--Sheet 2.

T. A. EDISON.

Printing Telegraphs.

No. 140,488. Patented July 1, 1873.



Witnesses

Chas. H. Smith

Geo. D. Walker

Inventor

Thomas A. Edison

for Lemuel W. Serrell att'y

3 Sheets--Sheet 3.

T. A. EDISON.
Printing Telegraphs.

No. 140,488.

Patented July 1, 1873.

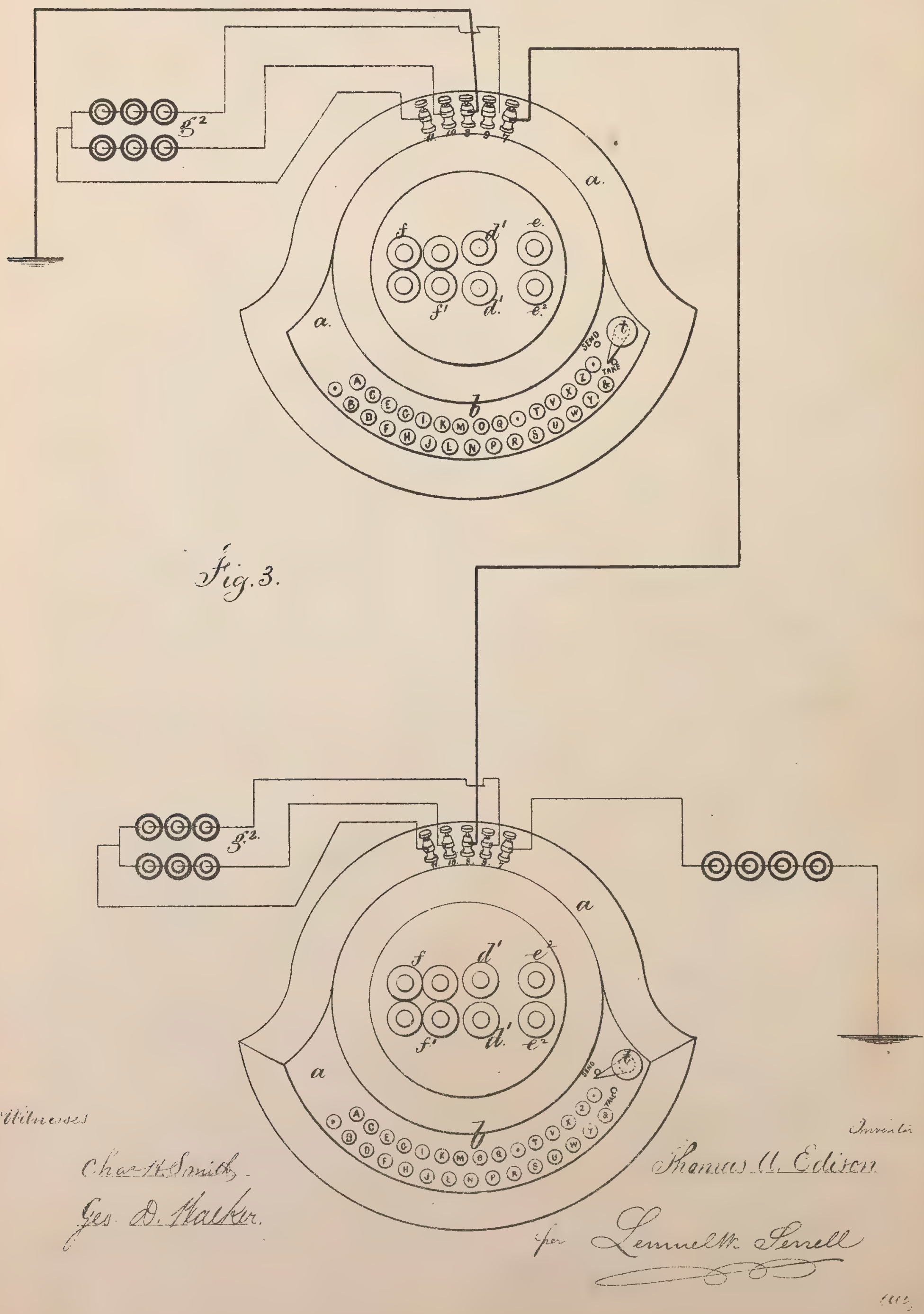


Fig. 3.

Witnesses

Chas. H. Smith

Geo. D. Walker.

Inventor

Thomas A. Edison

per Lemuel W. Serrell

att.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,488**, dated July 1, 1873; application filed May 16, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

In this machine there is a circuit-breaker driven by an electric engine, and this pulsator makes and breaks the circuit of the main line and causes all the type-wheels in the circuit to revolve in unison through the agency of an electro-magnet and step-by-step mechanism. When a key at the transmitting-station is depressed it stops the circuit-breaker and arrests the movement of the type-wheels. At each station is a local battery that is brought into action by the cessation in the movement of the type-wheel lever closing the circuit and throwing the current into the printing-magnet.

In the drawing, Figure 1 is an inverted plan, representing the principal portions of the mechanism. Fig. 2 is a vertical section, showing the operative portions of the machine; and Fig. 3 is a general plan view on a smaller scale, representing the connections.

The bed a of the machine is of suitable size and shape, and around on one side is a range of finger-keys, b, occupying one-third of the circle, and these are connected with the bars b', beneath the bed a, that stand radially around the wheel h^4 that is in the middle of the bed, and is hereafter referred to. The type-wheel c' is revolved by a step-by-step movement from the lever d, electro-magnet d^1, and spring 3. The unison mechanism e and the printing-lever e^1 and magnet e^2 are similar to those in my patent No. 126,532. The feeding mechanism for the paper is similar to that in my patent No. 126,532, and there is a pawl and retaining-clamp, 4, to prevent the paper drawing back, as in said patent. The motor consists of the electro-magnets $f\,f'$, vertical shaft g, and governor-balls g^1, and the speed is regulated by short-circuiting the battery-connection by the collar 5 and finger 6, as in my patent No. 131,343. The connections are made as shown in Fig. 3; the binding-screws 7 and 8 are the line-connections, or line and earth. The connection 9 is to the engine, and 10 to the printing-magnet, and 11 is the return-connection to the local battery g^2. The motor drives the wheel h by the pinion 13, and this communicates motion to the pinion 14 and a wheel, h^1, to which is attached a ratchet-wheel, k. The wheel h^4 is loose upon the same shaft as the wheels h^1 and k, and it is rotated by a pawl, 15, that is upon the wheel h^4, and takes the teeth of the ratchet-wheel k. The arms m, three in number, project from a hub around the shaft h^3. One of them is contiguous to a knuckle on the pawl 15, so that when one of the finger-keys b is depressed, and one of the arms m comes into contact with the bar b' of the depressed key, then the arms m are arrested, and the wheel h^4, moving slightly by the pawl, brings the knuckle of the pawl into contact with said arm m, and throws the pawl out from the ratchet-wheel k, thereby allowing the ratchet-wheel k and wheel h^1 to continue to revolve, but stopping the wheel h^4 and the parts deriving motion from it. In this manner the circuit-closing wheel o is stopped, said wheel receiving motion from the pinion o^2, and as soon as the finger-key is raised the spring o^3 throws the pawl 15 back into contact with the ratchet-wheel k, and the motion of the circuit-closing wheel is renewed. The lever s is operated by cam-projections on the wheel o, and, by the contact-points 20 and 35, and springs 21, the circuit next described is opened and closed. There is an insulated block, t, upon which the springs 22, 23, 24, and 25 rest, and in it are conducting-blocks. When a knob above the bed of the machine is turned to the word "take," the circuit is closed through the springs 22 and 23. When it is turned to the word "send," the circuit is closed through 24 and 25. The parts are so timed that the number of times the circuit is opened and closed during each revolution of the wheel h^4 equals three times the number of the keys b, and hence that the pulsations acting in the line make three revolutions of the type-wheel, the pulsations passing by the binder 7, wire 37, screw 36, metallic frame and lever s, contact-points 20 35, springs 21, and connection to the binder 33, wire 32, magnet d^1, wire 31, and binder 8, and thence along the line to the distant instruments, and setting their type-wheels,

and when the revolution of h^4 is stopped by depressing a key, the letter of the type-wheels corresponding to that on the depressed key is in position for printing. At the receiving instrument the block t is turned to take, and the circuit-closer is no longer included in the circuit, but the pulsations go direct through the magnet d^1 to set the type-wheel, the route being by binder 7, wire 37, binder 36, wire 38, spring-arms 22 and 23, wire 39, binder 33, wire 32, magnet d^1, wire 31, and binder 8 to line or earth connection. While the type-wheel lever d is vibrating the spring d^3 thereon does not remain in contact long enough with the anvil d^4 to energize the printing-magnet e^2; but so soon as the pulsation in the type-wheel magnet ceases the circuit is closed through d^3 and d^4, the current passing by binder 10, wire 40, magnet e^2, wire 49, anvil d^4, spring d^3, lever e^1, frame and bed a, and binder 11 back to battery g^2, and the printing effected. The fulcrum of the printing-lever e^1 is to be loose in its bearings, so that the momentum may carry the lever and its pad up to the type and produce the impression, and then fall away to prevent blurring the letter when the type-wheel is again revolved. The brass screws e^6 passing through the armature of the lever e^1, coming into contact with the cores of e^2, prevent adhesion between the surfaces and adjust the blow of the impression-pad. A ratchet-wheel, m^5, upon the governor-shaft g is provided, and a spring-pusher, m^6, is used to start the governor and motor in the right direction when the machine is put into motion. The contact-points 20 and spring contact-points 35 are in pairs, as seen in the detached view, Fig. 4, and two of the points touch before the other two, the object being to lessen the risk of false or defective pulsations, because the intensity of the spark between the contact-points produces oxidation that sometimes prevents the transmission of the pulsation. This spark is between the points that first come into contact; but if the spark fails between these it passes between the second pair of contact-points, and because this second pair is so seldom exposed to the action of the spark, their surfaces remain free from oxidation a very long time.

Stop-pawls have been used to prevent the type-wheel turning back, but they have been employed in connection with spring-pawls or on a separate ratchet-wheel. I employ the pawl e^7 and spring e^8 in connection with the wedge-acting pallets shown, and such pawl is so constructed that it prevents the type-wheel being turned the wrong way by holding the type-wheel in place when the pawls are not in contact with the ratchet-wheel, but are moving from one side to the other.

I claim as my invention—

1. The circuit-breaking wheel o actuated by the wheel h^4, in combination with the pawl 15, ratchet-wheel k, arms m, and range of finger-key bars b', substantially as and for the purposes set forth.

2. The switch-block t, circuit-springs 22 23 24 25 and their connections, substantially as set forth, in combination with the circuit-closer o, line-connections and type-wheel magnets d^1, substantially as set forth.

3. The starting mechanism, consisting of the pawl m^6 and ratchet-wheel m^5, in combination with the governor and magnetic motor, substantially as set forth.

4. The screws e^6 applied to the armature of the printing-magnet, for the purposes set forth.

5. The stop-pawl e^7, in combination with the type-wheel, wedge-acting pallets, and ratchet-wheel, for the purposes set forth.

6. The double pairs of spring circuit-closing points 20 and 35, one pair set to come into contact before the other pair, for the purposes set forth.

Signed by me this 23d day of April, A. D. 1873.

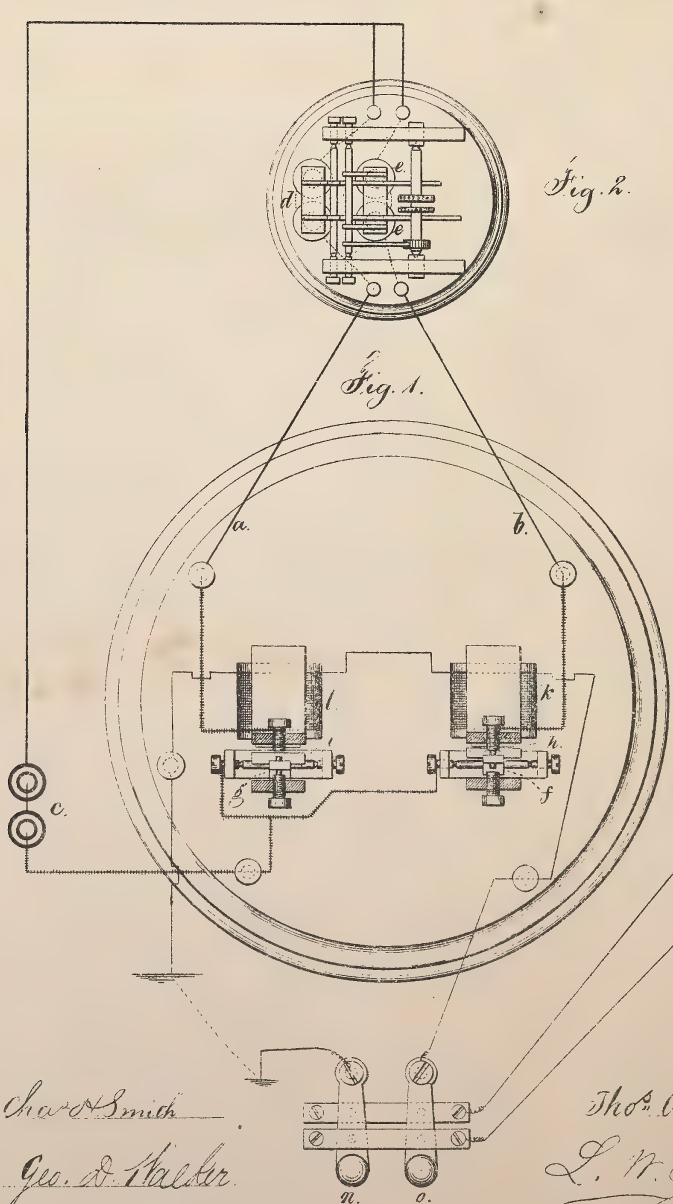
THOS. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

Circuits for Printing Telegraphs.

No. 140,489. Patented July 1, 1873.



Witnesses

Chas H Smith

Geo. D. Walker

Inventor

Thos. A. Edison,

L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CIRCUITS FOR PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **140,489**, dated July 1, 1873; application filed February 18, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Printing-Telegraph Instruments, of which the following is a specification:

In this instrument two relay-magnets are in a main-line circuit and their cores or armatures are polarized. The electro-magnets are so made that a pulsation of one polarity will attract one armature and repel the other, and the reverse when a current of opposite polarity is sent. The armatures of these electro-magnets open and close the circuits of a local battery, in which is placed the type-wheel and printing-magnets of a printing-telegraph instrument. When pulsations of one polarity act in the relay-magnets the type-wheel magnet of the printing-telegraph will be operated, and when a reverse polarity is sent through the relay-magnet the printing-circuit will be operated.

In the drawing, Figure 1 is a plan of the relay-magnets, and Fig. 2 represents the printing instrument and the circuits in which it is connected.

I remark that the printing instrument is to be of any desired character adapted to use with two circuit-connections, *a b*, such circuits passing, respectively, through the printing-magnet *d* and type-wheel magnet *e*. *c* represents the battery for the circuits *a b*, and this is connected with the circuit-closing levers *f* and *g*, upon which are the polarized armatures *h i* of the relay-magnets *k l*. These magnets *k l* are in the main circuit from the battery *m*, and when the key *n* at the distant station is depressed the pulsation passing through the magnets *k l* will be of negative polarity, and when *o* is depressed will be of positive polarity.

The electro-magnets *k l* are so made that when the key or pulsator *o* is operated, the magnet *k* will be operative upon its armature *h* to close and open the circuit *b* to the type-wheel magnet *e* and the armature *i* will be repelled; but when the type-wheel has been set the key *n* is to be depressed and the polarity reversed to act upon the armature *i*, and close the circuit *a* through the printing-magnets *d*, repelling the armature *h*.

By this transmitting mechanism the circuits *a b* can be operated at the distant station or stations with reliability and facility over a single line main circuit.

I remark that a pulsator-wheel and index-hand corresponding with the type-wheel may take the place of the keys *n o*.

The polarization of the electro-magnets may be effected by permanent magnetism in the core or armature, or in any convenient manner.

I claim as my invention—

Two polarized electro-magnets in a main circuit, in combination with two local circuit-connections to the magnets of a printing instrument, and a mechanism for opening and closing the main circuit and reversing the polarity of the current, substantially as and for the purposes set forth.

Signed by me this 13th day of February, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

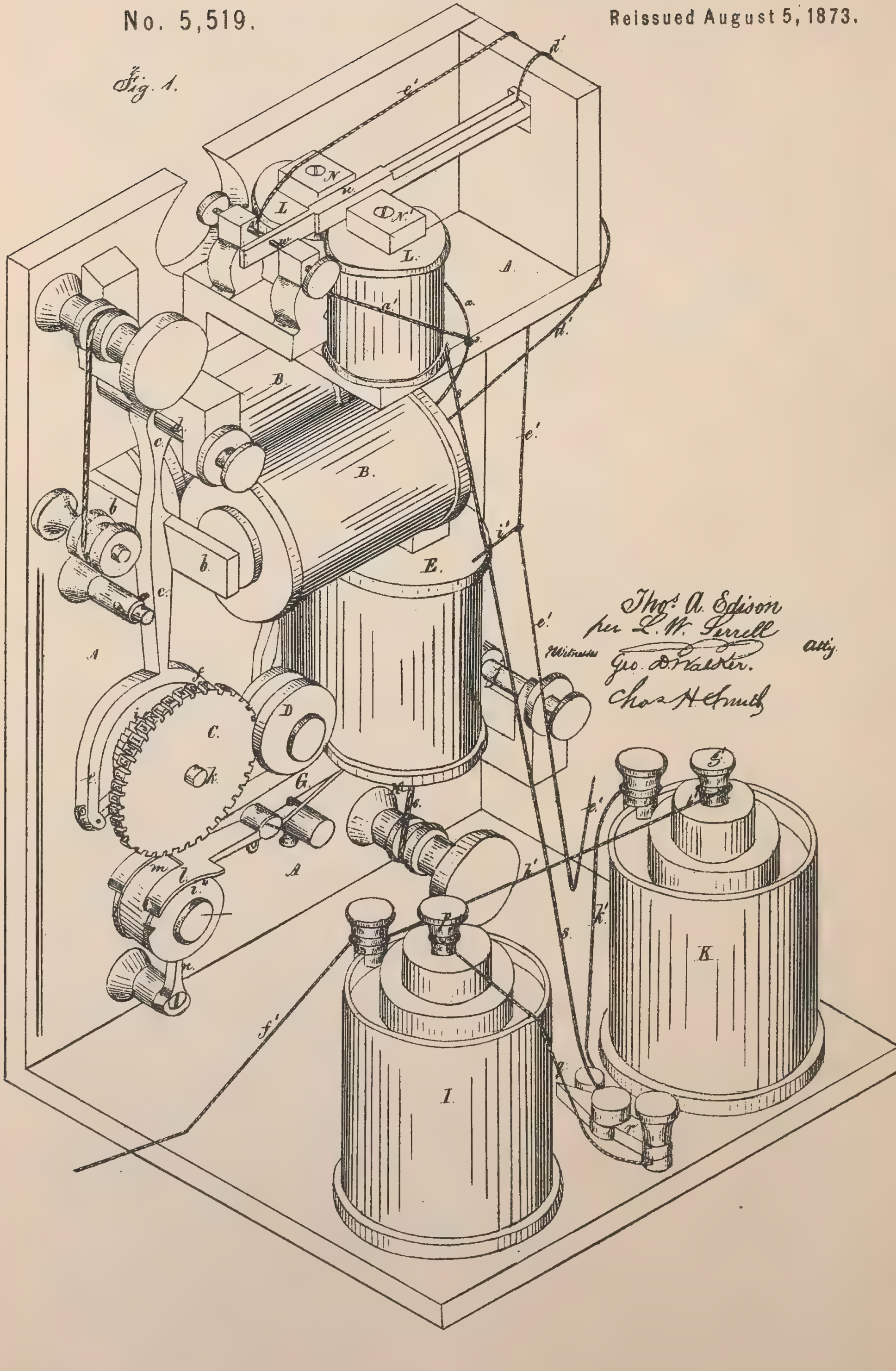
4 Sheets--Sheet 1.

T. A. EDISON.

Printing Telegraphs.

No. 5,519. Reissued August 5, 1873.

Fig. 1.



4 Sheets--Sheet 2.

T. A. EDISON.

Printing Telegraphs.

No. 5,519. Reissued August 5, 1873

Fig. 2.

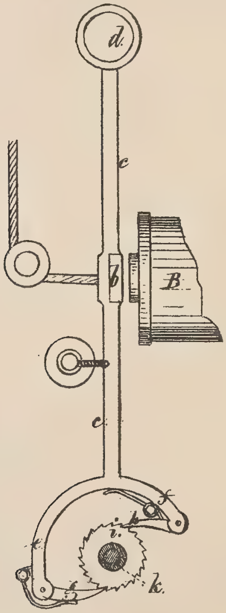
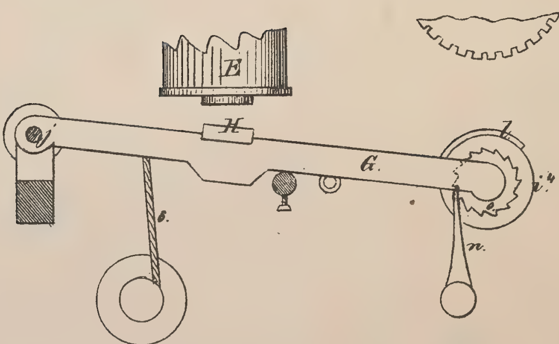


Fig. 3



Witnesses,

Geo D. Walker

Chas H. Smith

Thos. A. Edison.

per Lemuel W. Serrell atty

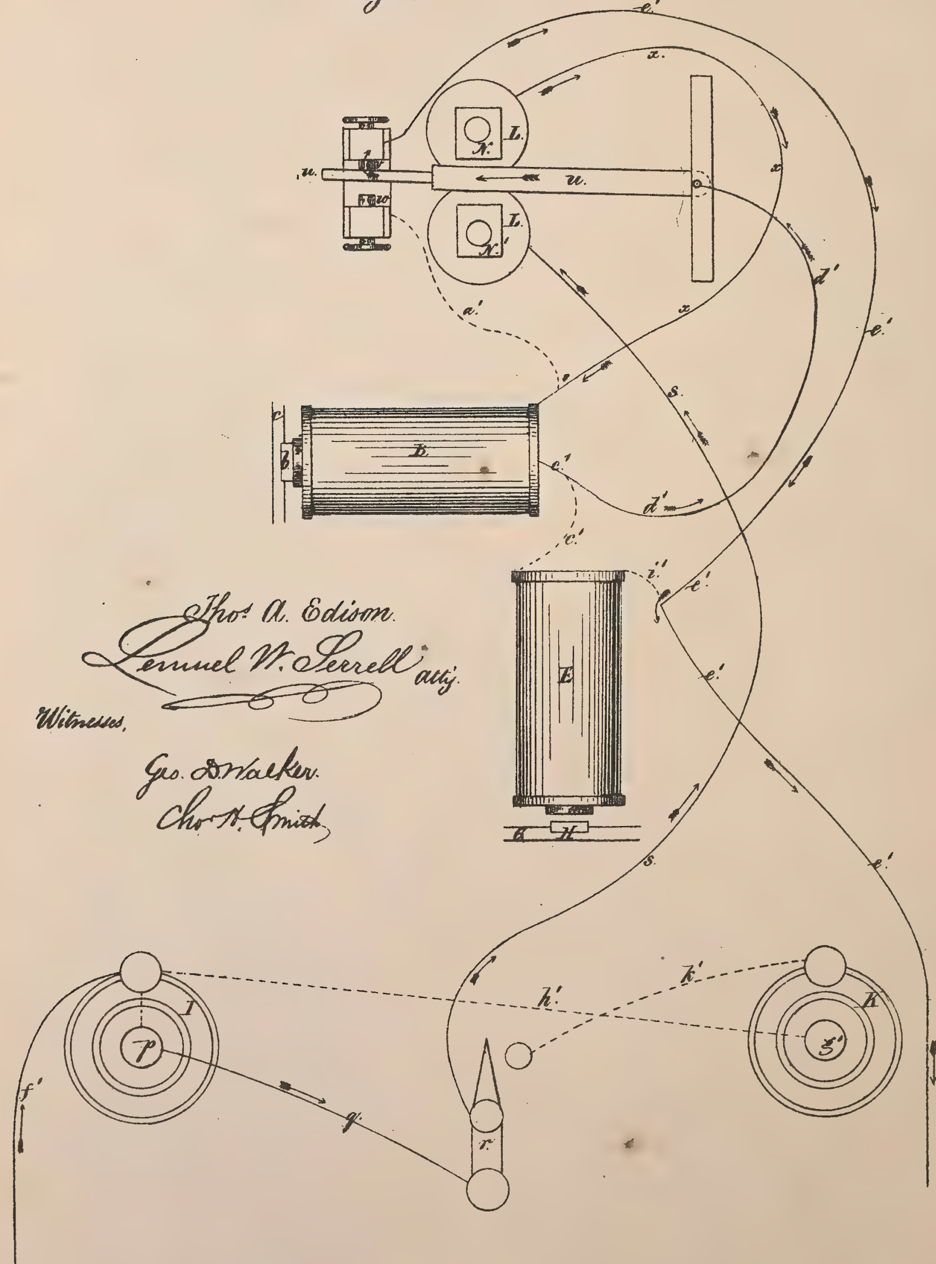
4 Sheets--Sheet 3.

T. A. EDISON.

Printing Telegraphs.

No. 5,519. Reissued August 5, 1873.

Fig. 4.



Thos. A. Edison.
Lemuel W. Serrell atty.

Witnesses,

Geo. D. Walker.
Chas. H. Smith

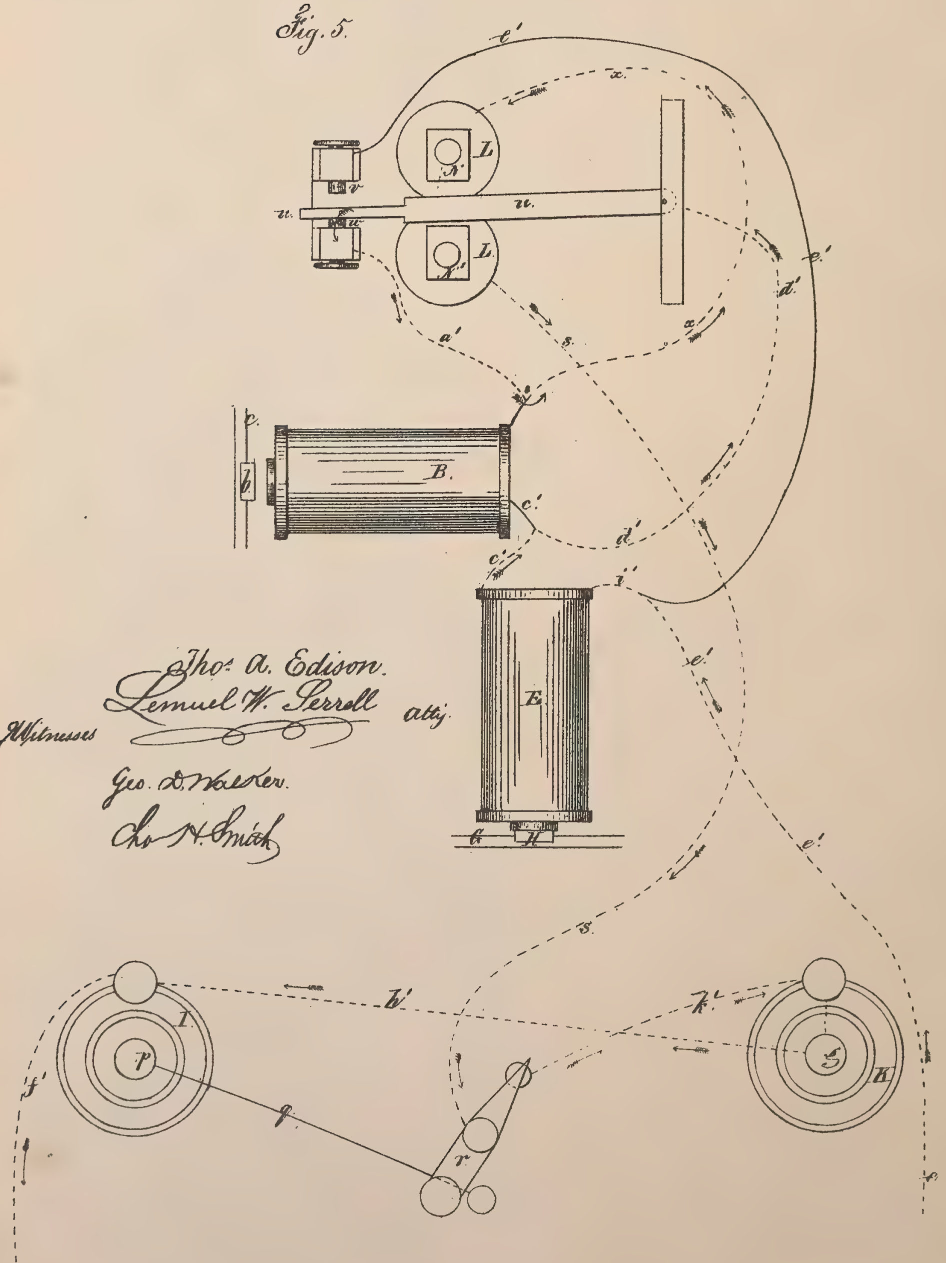
4 Sheets--Sheet 4.

T. A. EDISON.

Printing Telegraphs.

No. 5,519. Reissued August 5, 1873.

Fig. 5.



Thos. A. Edison.
Lemuel W. Serrell atty.

Witnesses
Geo. D. Walker.
Chs. H. Smith

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 91,527, dated June 22, 1869; reissue No. 4,166, dated October 25, 1870; reissue No. **5,519**, dated August 5, 1873; application filed June 19, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, now of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification.

In this printing-telegraph instrument the type-wheel is set by a step-by-step movement derived from an electro-magnet, and the impression is given by another magnet, and these magnets are connected with the main line and with a shunt in such a manner that the type-wheel magnet will be short-circuited when the printing is effected, thereby giving increased energy to the printing-magnet without enlarging the battery power. Several instruments are placed in the same circuit, and only one wire is required for operating the same, and the record is made at the receiving-station or stations without an operator being required at the receiving instrument. By reversing the polarity of the current a polarized switch is operated, and this becomes a circuit-changer to direct the pulsations from the receiving-station.

In the drawings, Figure 1 is a general perspective view. Fig. 2 represents the type-wheel magnet and mechanism for revolving the type-wheel. Fig. 3 shows the printing-lever, and Figs. 4 and 5 are diagrams illustrative of the circuit connections.

A represents the frame of the apparatus, to which is attached an electro-magnet, B B, of the usual construction. C is a type-wheel, whose periphery is provided with suitable letters or other characters, which revolves upon a stud or shaft, k. The armature b of the electro-magnet B is attached to a lever, c, suspended upon an arbor, d. The lower end of the lever c is bifurcated, as seen in Figs. 1 and 2, the two arms e f carrying pawls g h, which engage at opposite points upon the periphery of the ratchet-wheel i, which is fixed upon the same shaft as the type-wheel C, and revolves with it.

It will be understood, by reference to Fig. 2, that each vibration of the lever c backward or forward will cause the ratchet-wheel i to advance in its revolution the distance of one tooth in the same direction.

The type-wheel C receives its supply of ink from the roller D in any well-known manner.

The electro-magnet E is similar to the electro-magnet B, and is attached to the frame A. The armature H is attached to the lever G, and swings upon its axis at j. At its opposite extremity is a roller, i^4, which occupies a position immediately beneath the type-wheel C.

The strip of paper upon which the communications are to be printed is led from a suitable reel, not shown, over the roller i^4, upon which it is held with a sufficient degree of friction by a spring-arm, l, provided with an open slot, m, so that when the roller i^4 is raised by the action of the electro-magnet E upon the lever G the strip of paper is brought in contact with whatever letter or character may at that time be opposite upon the type-wheel C, thereby printing the impression of said letter or character upon the paper. When the action of the electro-magnet E ceases the lever G is drawn back to its original position by a spring, 6.

After each impression has been made the strip of paper is moved forward by means of a pawl, n, which, when the lever G is drawn back, engages with the teeth of a ratchet-wheel, o, Fig. 3, which is secured to the roller i^4, causing the said roller to revolve and draw the paper forward a sufficient distance to produce the required space between the letters.

The edges 7 of the roller i^4 are roughened to prevent the paper from slipping during the movement.

The electro-magnet L is in the main circuit, and the electro-magnets B and E are also in the main circuit, and the circuit-changer or switch u is operated by this magnet L, and the shunt-connections that act to direct or short-circuit the current are illustrated in Figs. 4 and 5.

The batteries I and K are of any usual character. A switch, r, is shown for connecting one battery or the other, and thereby reversing the circuit, as illustrated by the arrows in

Figs. 4 and 5, f' h' representing the ground-wires or earth-connections, s the line to the distant instrument, and e' the line to the next instrument or to the earth.

By referring to Fig. 4 it will be understood that pulsations sent from the battery to the distant station by a finger-key or any competent circuit-breaker travel over the line-wires s, through the magnet L, wire x, and magnet B, to set the type-wheel; thence, by d' u v e' and earth-connection, to f', p, and q to r.

When the type-wheel is set the pole N' attracts the switch u, and the printing-magnet is energized by a shunting operation, as seen in Fig. 5. The current passes through e', i', E, c', d', u, w, a', x, L, and s; thereby the switch or circuit-changer u connects the circuits, so that the type-wheel magnet B is shunted or short-circuited, for, although the magnet B still remains in the metallic circuit, the electric current will principally pass over the route of least resistance from c' to d', u, a', and x, instead of going from c' through B to x.

The shunt circuit-changer or a polarized relay, being well known, may be of any desired character, and my invention does not relate to the same.

Under all circumstances the electro-magnet L is the means for operating the circuit-changer or shunt-switch u; and when this is made as a polarized bar it will be changed from w to v according to the polarity of the current. I avail, therefore, of this means for moving the circuit-changer u, and employ pulsations of one polarity to set the type-wheel, and then a current of reverse polarity to effect the printing.

It will be evident that when the change of polarity is made use of the arrangement of the circuits shown in Fig. 4 causes the shunt-switch u to short-circuit the printing-magnet E while the type-wheel is being set by pulsations acting in the magnet B, the magnet E remaining in the metallic circuit; but the principal portion of the current, taking the route of least resistance by d', u, v, and e', instead of going from d' by c', E, and i' to e'; and when the change of polarity in the current is employed to effect the movement in the shunt-switch u the type-wheel magnet B is short-circuited or shunted as before.

The switch u is so made that it will move more rapidly than either of the armatures of the magnets E B. Hence one or the other of the magnets will be shunted by the movement of the switch, and there will not be any false movement of either armature.

The above-described invention is designed particularly for transmitting intelligence from a central station to a number of receiving-stations included in the circuit, in which case no batteries or operators will be required at the receiving-stations; but if messages are to be sent from each station as well as received, then each instrument will require to be provided with a transmitting instrument, a battery, and an ordinary switch connected with a ground-wire.

What is claimed as the invention of said T. A. Edison is—

1. A printing-telegraph instrument with the printing and type-wheel magnets in the metallic circuit forming part of the main line, and a shunt-switch operated by electro-magnetism to divert the current from the type-wheel magnet while the printing is effected, substantially as set forth.

2. A separate magnet in the main line to cut out, by a switch and shunt connection, either the printing or the type-wheel magnets, substantially as set forth.

3. In a printing-telegraph instrument, three electro-magnets within the metallic circuit forming part of the main line, and a shunt-switch operated by magnetism, whereby the current is diverted or short-circuited from one magnet by the movement of the switch, substantially as set forth.

4. Two or more printing-telegraph instruments placed in one main circuit, and operated simultaneously by pulsations of electricity, the type-wheel being set by pulsations of one polarity, and the printing being effected by pulsations of the opposite polarity, substantially as set forth.

5. Two or more printing-telegraph instruments placed in one main circuit, with all the electro-magnets in metallic connection with that circuit, so that the entire circuits remain unbroken, in combination with shunts and switches actuated by magnetism to direct the current principally through the printing-magnets when the impression is to be made, substantially as set forth.

MARSHALL LEFFERTS,
President the Gold and Stock Telegraph Co.
NORMAN C. MILLER,
Secretary.

Witnesses:
Geo. T. Pinckney,
Chas. H. Smith.

2 Sheets--Sheet 1.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

No. 5,523. Reissued August 5, 1873.

Fig. 1.

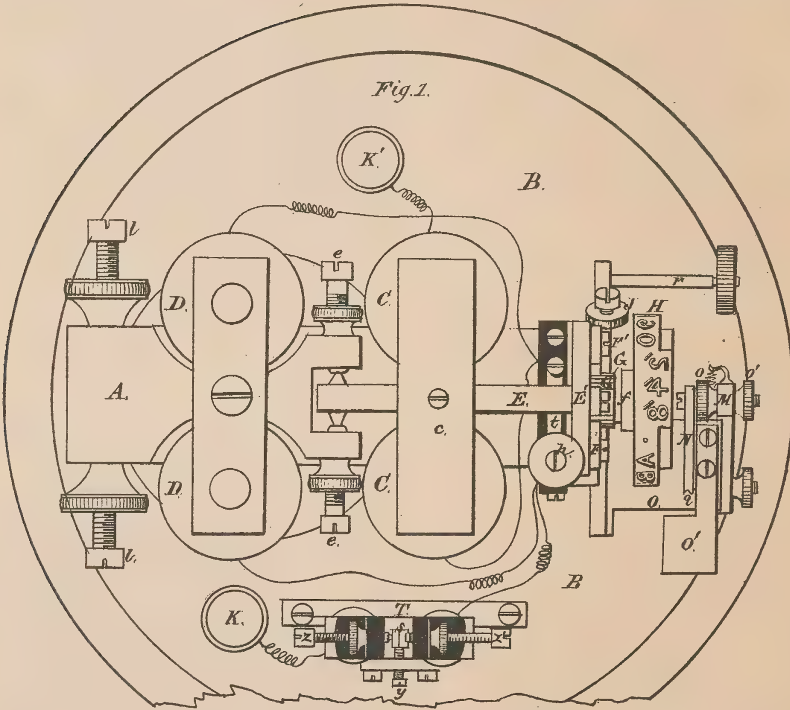
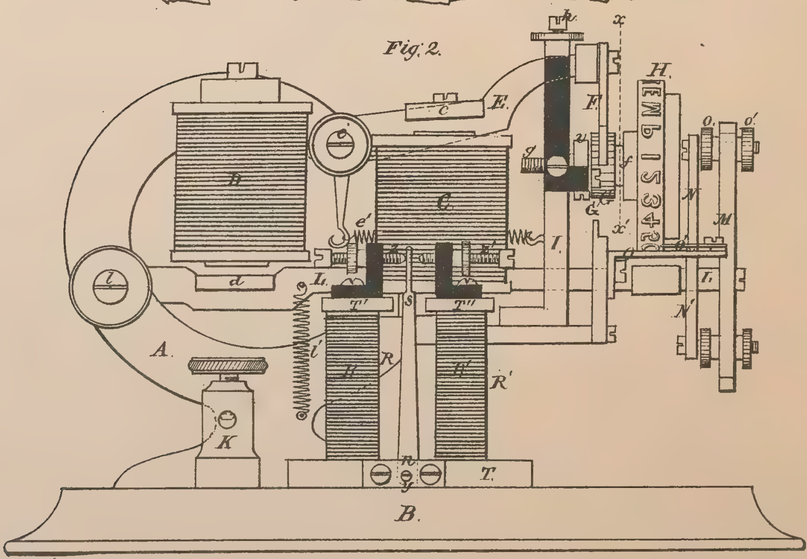


Fig. 2.



Witnesses.
M. M. Livingston
T. B. Brecken

Inventors.
Frank L. Pope
Thomas A Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets--Sheet 2.

F. L. POPE & T. A. EDISON.

Printing Telegraphs.

No. 5,523. Reissued August 5, 1873.

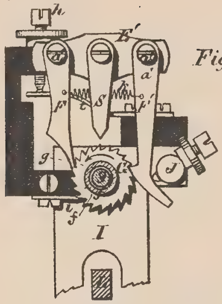


Fig.3.

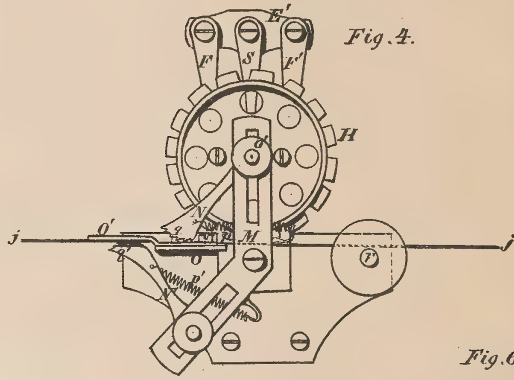


Fig.4.

Fig.5.

Fig.6.

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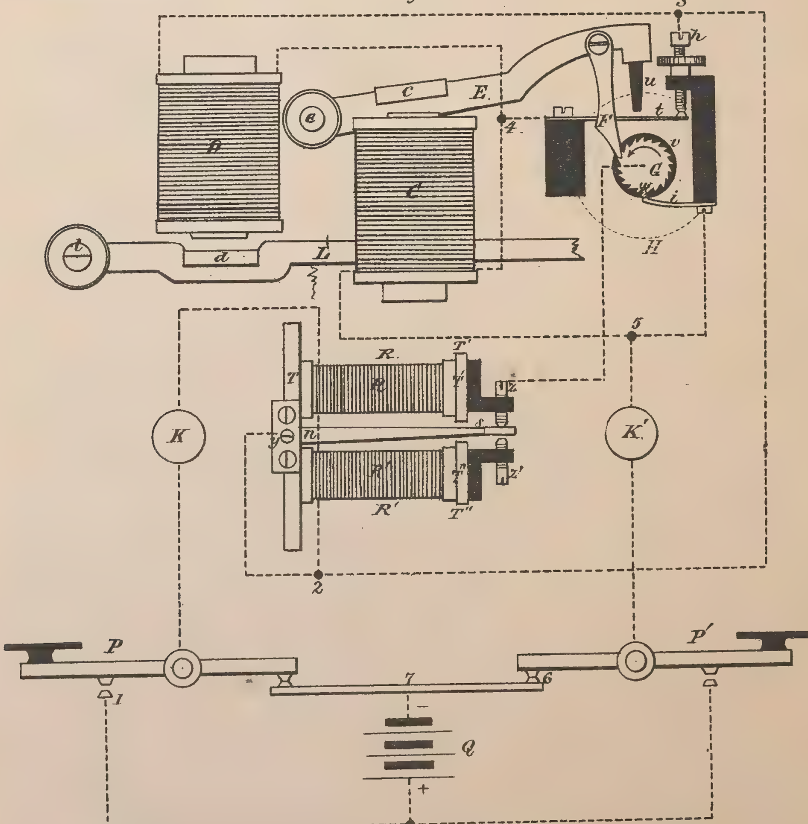
Fig.7.



Witnesses; M. M. Livingston
T. B. Beecher

Inventors; Frank L. Pope
Thomas A Edison

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D C

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, AND THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK CITY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 103,924, dated June 7, 1870; Reissue No. **5,523**, dated August 5, 1873; application filed June 19, 1873.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, formerly of the city and State of New York, now of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Printing-Telegraphs, of which the following is a specification:

The object of this invention is to furnish a telegraphic instrument by means of which communications may not only be recorded automatically, in printed characters, at one or more distant points, at the pleasure of the transmitting-operator, but by which this result may be accomplished with greater certainty, and in a much more simple manner, than by the apparatus hitherto used for this purpose.

The principal features of this improvement may be stated as follows: First, to the placing of the electro-magnet which rotates the type-wheel in the same electrical circuit with a second electro-magnet which operates the printing mechanism, and so arranging them that the printing mechanism will act in consequence of a pause when the type-wheel has been brought to its desired position. Second, to a shunt applied in the circuit that passes to the printing and type wheel electro-magnets, to intensify the action of the printing-magnet after the type-wheel has been set, whereby the rapidity of the instrument will be promoted without necessarily increasing the power of the battery. Third, to the use of an electrical cut-off, which we term the unison cut-off, and by means of which any number of printing-telegraph instruments may be brought into correspondence with the transmitting instrument at the pleasure of the transmitting-operator. Fourth, to the use of an electro-magnetic switch of peculiar construction, which is employed for the purpose of placing the unison cut-off in circuit, and which may also be made useful for other purposes in connection with printing-telegraph instruments. Fifth, to an improved paper-feeding mechanism for printing-telegraph instruments. Sixth, to the placing of certain duplicate figures or characters in a peculiar position upon the type-wheel, for purposes hereinafter specified.

The arrangement of the various parts of this invention will be more fully understood by reference to the accompanying drawing, in which—

Figure 1 represents a plan view of the receiving and recording apparatus. Fig. 2 is a side elevation of the same. Fig. 3 is a sectional front view of a portion of the apparatus taken through the line $x\ x'$, Fig. 2. Fig. 4 is a detached front view, showing the device for moving the paper forward beneath the type-wheel. Fig. 5 is a sectional view, showing the details of the unison cut-off. Fig. 6 illustrates the manner in which numbers and fractions are printed by the apparatus. Fig. 7 is a theoretical diagram designed to show the electrical connections of the various parts of the apparatus and their relations to each other, whereby the desired results are obtained.

A (see Figs. 1 and 2) designates a metallic frame or standard, which is firmly secured to the pedestal or base b, and which serves as a support to the different portions of the receiving instrument. An electro-magnet, C, is secured, preferably in an upright position, upon the lower portion of the frame A, and a second similar electro-magnet, D, is placed, in a preferably inverted position, upon the upper portion of the said frame. The armature c of the electro-magnet C is attached to a lever, e, which moves upon pivots $e\ e$ fixed in the upper extremity of the frame A. A pawl, F, Figs. 1, 2, 3, and 4, is pivoted at a to the cross-head E′ at or near the end of the lever E. This pawl engages with the teeth of a ratchet-wheel, G, as shown in Fig. 3. The ratchet-wheel G, and also the type-wheel H, are mounted upon a sleeve, f, which revolves upon a stationary spindle, g, projecting from the standard I, which latter is supported by the frame A. This arrangement will be clearly understood by reference to Figs. 1, 2, and 3. The cross-head E′, Fig. 3, is also provided with a second pawl, F′,

which is pivoted at a', and is provided at one end with a hook, which acts upon the opposite side of the wheel G. A stop, S, is permanently secured to the cross-head E' midway between the pawls F and F'. The pawls F and F' are kept in contact with the face of the wheel G by means of a spring, K, or in any other suitable manner.

By reference to Fig. 3 it will readily be understood that a downward movement of the lever E and the cross-head E', caused by the attraction of the electro-magnet C, will cause the pawl F to engage with a tooth of the ratchet-wheel G, and cause the latter to rotate the distance of half the depth of the tooth in the direction of the arrow, when its movement is arrested by the stop S coming between the teeth of the wheel G. The pawl F' has meantime passed one tooth of the wheel G, and when the lever E returns to its former position it engages with the said tooth and rotates the wheel the distance of half the depth of a tooth farther, when its motion is arrested by the stop J. Thus each movement of the lever E, in both directions, advances the wheel G one tooth in the direction of the arrow, and an intermittent rotary motion is imparted to said wheel G by the vibrations of the lever E under the influence of the electro-magnet C. This intermittent rotary motion is imparted to the sleeve f and the type-wheel H. The ratchet-wheel G is provided with a number of teeth corresponding to the number of letters, figures, or characters upon the circumference of the type-wheel G, so that the latter may be brought to any desired position by transmitting the appropriate number of electrical pulsations through the electro-magnet C, each pulsation advancing the wheel G one tooth, and the type-wheel H one character, through the medium of the armature c, lever E, and pawl F, as hereinbefore explained.

The electrical connections between the different portions of the apparatus are only partially seen in Figs. 1 and 2, but are fully shown in Fig. 7, which will be hereafter explained.

The apparatus for taking the impression of any desired letter, when the type-wheel has been brought to the proper position, is constructed and operates as follows: Underneath the electro-magnet D, Fig. 2, is a horizontal lever, L, to which its armature d is attached. This lever is capable of a slight vertical motion upon the pivots l l. The lever L passes between the helices of the electro-magnet C, and through an aperture in the standard I. The strip of paper j j, Fig. 4, passes over the extremity of the lever L and underneath the type-wheel H. When the electro-magnet D becomes sufficiently excited by the passage of the electrical current its attraction will be exerted upon the armature d, thereby raising the lever L and bringing the strip of paper j j forcibly in contact with the character upon the type-wheel H, which is over it at the time. The characters upon the type-wheel having been previously inked by means of an inking-roller or other suitable device, an impression of the said character is made upon the paper. Upon the cessation of the electric current in the coils of the electro-magnet D the lever L is drawn back to its original position by means of the spring l'.

The device for moving the paper forward after each impression has been made is constructed and operates as follows: Upon the end of the lever L there is secured a slotted bar, M, Figs. 1, 2, and 4, which moves vertically with said lever L. To the upper portion of this bar there is attached a feeder, N, by means of adjustable set-screws o and o', which allow of its being secured at any desired point upon the bar M. The feeder N is placed in an inclined position, as shown in Fig. 4, its lower extremity being serrated or provided with spurs q' and resting upon the strip of paper j j, which at that point is supported by the bed-plate O. The feeder N is kept in contact with the paper by means of a spiral spring, q. A second feeder, N', is attached in the same manner to the lower part of the bar M, so as to rest against the under side of the strip of paper at q', which paper passes underneath the plate O', as shown in Figs. 1, 2, and 4. By an inspection of Fig. 4 it will be understood that when the lever L and its bar M descend, after an impression has been made, the lower end of the feeder N is thrust to the left, and the paper is pushed forward by its spurs q. When the lever L is again moved upward the feeder N' in the same manner advances the paper still farther to the left. By this arrangement the feeders N and N' may be so adjusted that a comparatively slight vertical movement of the lever L will cause a considerable horizontal movement of the strip of paper j j, and the amount of this movement may be regulated at pleasure by altering the position of the set screws o and o upon the bar M.

The manner in which the several parts of the apparatus are electrically connected and operated will be understood by reference to Fig. 7, which is a theoretical diagram showing the various parts heretofore described, in relation to each other and with their proper electrical connections.

In Fig. 7, Q represents a voltaic battery of any suitable construction, the positive and negative poles of said battery being distinguished in the drawing by the signs + and —. P is a key or circuit-breaker, which may be of any suitable construction. The battery Q and key P, it is to be understood, are situated at the transmitting-station. By means of the circuit-breaker P a series of successive pulsations may be transmitted through the conducting-wires and the electro-magnets of the receiving apparatus. Starting from the positive pole of the battery Q, the circuit may be traced to the anvil 1 of the key P, thence through the electro-magnet R R, (for purposes hereinafter explained,) to the point 2, and thence to the point 3. From the point 3 to the point 4 two routes are open to the current, one through the hel-

ices of the electro-magnet D and the other through the screw h and flat spring t. The latter route being much the shortest and offering little or no resistance to the passage of the current, the electro-magnet D will not be perceptibly affected by the passage of the current as long as the branch circuit through h and t remains uninterrupted. From the point 4 the current passes through the helices of the electro-magnet C to the point 5, and thence by 6 and 7 to the other pole of the battery Q. When the lever E is drawn down by the action of the electro-magnet C an insulated pin, u, Fig. 7, strikes the spring t just before the movement of the former is arrested, and breaks the electrical contact between it and the screw h. The entire current is therefore momentarily thrown through the helices of the electro-magnet D at each vibration of the lever E; but when these vibrations are performed with considerable rapidity the electro-magnet D is not kept in circuit long enough to become completely magnetized. When the circuit remains closed for a longer time the electro-magnet D becomes fully magnetized and attracts its armature d, thereby raising the lever L and bringing the strip of paper j j against the type upon the type-wheel H.

It will therefore be understood from the above explanation that the impression of any given character upon the type-wheel H may be produced upon the paper j j by an operator stationed at a distant point—as, for example, at P (see Fig. 7)—simply by transmitting the proper number of electrical impulses of short duration by means of a properly-constructed circuit-breaker, which will cause the type-wheel H to revolve without sensibly affecting the impression device.

When the desired character is brought opposite the impression-lever L the duration of the final current is prolonged, and the electro-magnet D becomes fully magnetized, and therefore an impression of the letter or character upon the paper is produced in the same manner hereinbefore described.

When a number of automatic printing-telegraph instruments are situated at different points and operated simultaneously in one circuit, it is desirable that some suitable means may be provided whereby the transmitting-operator may be enabled to bring the type-wheels of the several receiving or recording instruments into correspondence at pleasure. This is effected by the following device: Upon the sleeve f, which carries the type-wheel H and ratchet-wheel G, is secured a collar, v, Figs. 2, 5, and 7. This collar is composed of some suitable insulating material. We will here observe that in all the figures the non-conducting material employed to insulate one portion of the apparatus from another is represented in black. A metallic spring, i, fixed upon an insulating-support, Figs. 5 and 7, presses against this collar as it revolves. A metallic pin or stud, w, is inserted into the sleeve f, passing through the insulating-collar, as shown in Figs. 5 and 7, in such a manner as to form an electrical connection between the sleeve f and the spring i whenever the pin or stud w is brought in contact with said spring by the revolution of the sleeve f. This arrangement is clearly shown in Figs. 5 and 7.

By reference to Fig. 7, in which the electrical connections are shown in dotted lines, it will be understood that this connection forms a short circuit between the point 2 and the point 5, cutting off nearly all the electric current from the electro-magnets C and D, and thereby arresting their action. This short circuit may be brought into action at the pleasure of the transmitting-operator by means of the device next described. R R′, Figs. 3 and 7, designate the helices of a small electro-magnet, whose poles are shown at T^1 and T^2, the opposite ends of the cores being screwed into the soft-iron bar T. A permanently-magnetized steel bar, n s, is pivoted to the bar T at y, its opposite extremities being free to vibrate between the screws Z and Z′.

In consequence of a well-known law of magnetic action, when a current from the battery Q passes through the helices of the electro-magnet R R′ in one direction the south end s of the magnet-bar n s will be attracted by T^1 and repelled by T^2, while a current in the opposite direction will produce the reverse effect. One pole of the polarized bar n s being in magnetic contact with the mass of soft iron formed by the bar T and its attachments, its magnetism cannot be weakened or reversed, as is often the case with magnetized armatures which are not in magnetic contact with the soft iron of the electro-magnet.

From this explanation, and by reference to Fig. 7, it will be readily understood that the transmitting operator, by employing the circuit-breaker P′ instead of P, can send a series of electrical pulsations through the circuit in the opposite direction, which will cause the south end s of the bar n s to be deflected toward T^1, so as to come in contact with the stop z.

As it is a matter of indifference in which direction the current passes through the electro-magnet C in order to operate it, the type-wheel of each instrument will continue to revolve by its action, as usual, until the pin or stud w comes in contact with the spring i, when a short circuit will be formed from 2, Fig. 7, through n, s, and z, to the metallic frame of the instrument, and thence through sleeve f, pin or stud w, and spring i, to the point 5, and thence by the usual route. The principal part of the current will take the shorter route, just described, and the action of the electro-magnet C, and consequently, the movement of the type-wheel H, will be arrested. Each instrument in the circuit will therefore stop automatically at the same point in the revolution of the type-wheel H and sleeve f. When this has been accomplished the electric cur-

rent is again reversed, and the operation of the apparatus proceeds as usual.

When the instrument hereinbefore described is intended to be used for recording quotations of markets, &c., wherein the amounts to be represented fluctuate by eighths of one per cent., three duplicate figures or characters are placed upon the periphery of the type-wheel H in such a position as to impress themselves upon the strip of paper lower than the line of the other figures or characters upon the wheel, which may be used in combination with the ordinary numerals to indicate fractional quantities. The arrangement of these characters upon the type-wheel is shown in Fig. 1, and the manner in which their impressions upon the paper are combined with those of the numerals to represent fractional quantities is shown in Fig. 6. By means of this device the total number of characters upon the type-wheel may be considerably reduced, and the speed of transmission correspondingly augmented.

It is obvious that letters as well as characters may be placed upon the type-wheel in a different circumferential plane in the same manner as the figures just referred to, and in such cases the letters, figures, or characters in the one circumferential plane would be opposite blank spaces in the other circumferential plane, and hence no two letters, figures, or characters would be in the same axial plane. This arrangement of letters, figures, or characters upon the type-wheel of a printing telegraph we believe to be new.

No claim is made to an electro-magnet for operating the type-wheel of a printing-telegraph instrument in the same circuit with the electro-magnet that actuates the printing mechanism; nor to the use of a device for bringing the transmitting and receiving apparatus into unison from the transmitting-station, as this is shown in the patent granted to Charles Kirchof, April 15, 1856, and also in the patent granted to S. S. Laws, January 25, 1870.

What is claimed as the invention of said F. L. Pope and T. A. Edison is—

1. In a printing-telegraph instrument, the arrangement of two electro-magnets in the same electrical circuit, one being employed to rotate the type-wheel and the other to actuate the printing mechanism, when the action of the latter is controlled by that of the former by means of a branch or short circuit and a mechanical cut-off, or its equivalent, constructed and operated substantially as described.

2. An improved cut-off, termed an electrical-unison cut-off, whereby, at a given point in the revolution of a ratchet or type wheel, a shunt or branch circuit may be brought into action, and the electrical current diverted from the electro-magnet controlling the movement of the said ratchet or type wheel, so that the said movement may be arrested at such given point, the same being constructed and operated substantially as specified.

3. The electro-magnet R R′ and soft-iron bar T, in combination with a polarized-steel bar, *n s*, so arranged that said steel bar will be in magnetic contact with the said soft-iron bar, substantially as herein specified.

4. The bar M, feeder N or N′, spurs *q* or *q′*, bed-plates O or O′, combined, arranged, and operating substantially as described, and for the purposes specified.

5. The combination of the lever E, pawls F and F′, stops S and J, and ratchet-wheel G, arranged and operating substantially as described.

6. The combination of the pawl F, stop S, and ratchet-wheel G, substantially as and for the purposes specified.

7. The electro-magnet R R′, soft-iron bar T, and polarized-steel bar *n s*, in combination with the spring *i*, insulated collar *v*, and pin or stud *w*, in the manner described, and for the purposes specified.

8. The combination, with an electro-magnet in a telegraphic-printing apparatus, of a type-wheel whose periphery is provided with integral numbers, so arranged upon said type-wheel that fractions of numbers may be printed upon the paper, thereby decreasing the number of characters upon the type-wheel and insuring great rapidity in recording, substantially as herein shown and described.

9. In a printing-telegraph, a type-wheel provided with letters, figures, or characters, which are arranged in two different lines around the periphery of said wheel, and in such manner that the said letters, figures, or characters in the one line shall be opposite blank spaces in the other line, substantially as herein specified.

10. A printing-telegraph instrument with the metallic circuit of the main line passing through both the type-wheel and the printing electro-magnets, in combination with a shunt circuit or switch that operates to energize the printing-magnet during a pause after the type-wheel has been set.

Signed this 16th day of June, A. D. 1873.

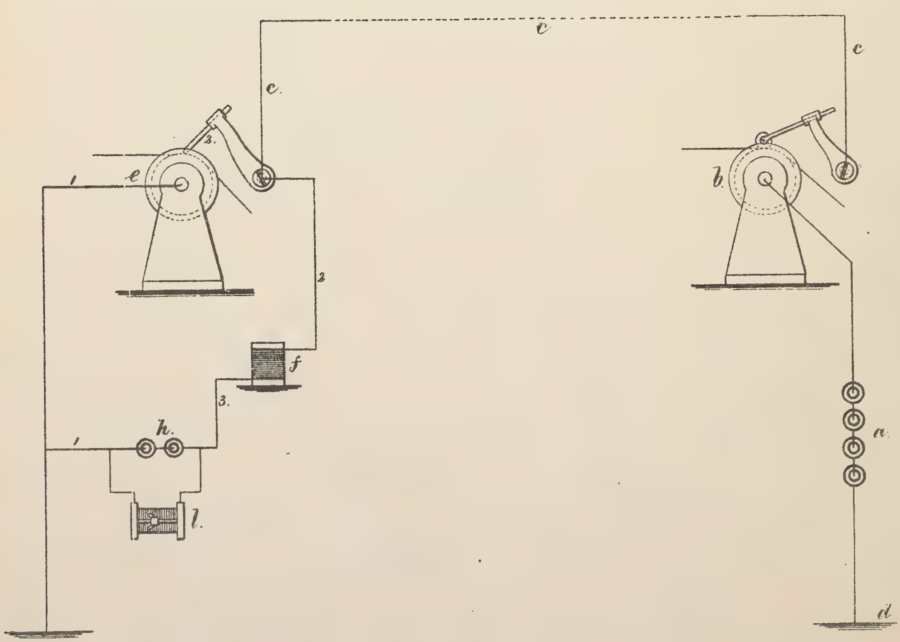
MARSHALL LEFFERTS,
President the Gold and Stock Telegraph Co.
NORMAN C. MILLER,
Secretary.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic or Chemical Telegraphs.

No. 141,772. Patented August 12, 1873.



Witnesses,

Chas. H. Smith

Geo. D. Walker

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC OR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **141,772**, dated August 12, 1873; application filed November 9, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

In chemical telegraphs it often happens that the pulsations of electricity that reach the paper are too powerful; and hence there is an elongation or attenuation of the mark upon the paper, causing the characters to be indistinct or to run into each other.

The present invention is to prevent this difficulty by regulating the quantity of the current passing to the chemical paper, and then bringing in an adjustable reverse current to neutralize any tailings.

In the annexed diagram the peculiarity of arrangement of circuits and instruments is illustrated.

A battery, *a*, is connected through the transmitting instrument *b* to the line-wire *c*, and the earth connection *d* is of the usual character. At the receiving-station the instrument *e* is to be of ordinary character for presenting the chemical paper to the action of the stylus and current. Rheostats have been used between the main-line and receiving instrument, and also in a shunt or branch circuit connected with the earth, and a battery has been placed in the shunt or branch circuit. I employ a rheostat, *f*, in a shunt connection between the parts of the main line, through which a portion of the electric pulsation passes, the rheostat being sufficient to counteract the resistance of the chemical paper, and cause the proper proportion of current to pass through said paper. The battery *h* is placed in the main or branch line with its poles in a position to cause the electricity to circulate through the local circuit composed of 1, *e*, 2, *f*, and 3, in a direction opposite to that in the main line, so that any attenuation of the mark may be prevented by the reverse action of the currents. If the before-mentioned parts only were employed, the local battery *h* might be sufficient to neutralize the electric pulsations in the main line. I therefore introduce a rheostat, *l*, between the poles of the battery *h*, and the same should be variable or adjustable to allow the action of the battery *h* to be varied, and only so much of the reverse current directed through the local circuit and the chemical paper as will prevent the attenuation or tailing of the mark upon the chemical paper, leaving that mark clear and distinct.

I claim as my invention—

The rheostat *l* applied to the battery *h* in the local circuit to regulate the action thereof, in combination with the rheostat *f* in the branch circuit, and the receiving instrument in the main circuit, substantially as and for the purposes set forth.

Signed by me this 5th day of November, A. D. 1872.

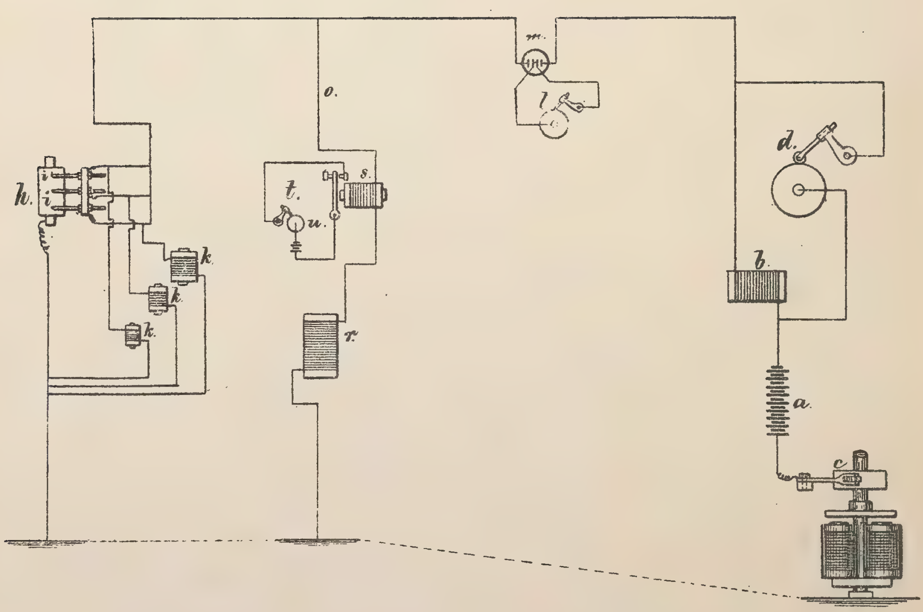
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic Telegraphs.

No. 141,773. Patented August 12, 1873.



Witnesses.

Chas H. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison.

Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,773**, dated August 12, 1873; application filed January 15, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Circuits for Chemical Telegraphs, of which the following is a specification:

This invention is intended for rendering the reception of the message more reliable and free from blurring or tailings upon the chemical paper. The line is kept statically charged by a battery, the circuit of which is interrupted with immense rapidity by an electromagnetic engine or other device. At the receiving end there is a shunt with an electromagnet in it. The electric tension is adjusted by a rheostat at the transmitting-station, so that ordinarily there will not be any mark at the receiving-station in consequence of the electro-magnet and shunt; but when the tension in the line is increased by the current going through the perforations of the paper at the transmitter and directly to the line, so as to cut out the rheostat, then a mark is made at the receiving-instrument, but there will not be any attenuation of the pulsation to produce tailings.

At the receiving-station I employ two or more styluses or pens, all connected with the main line, and to each is a shunt-circuit and an electro-magnet. The magnets are of varying character or power; hence they will act differently upon the stylus, and one will be sure to make a legible mark, although the electric conditions may vary from time to time or during the reception of the message, and the operator will be able to read the message reliably upon one of the two or more corresponding lines of marks on the strip before him.

In the diagram I have illustrated my improvement.

The battery *a*, rheostat *b*, and rapid contact-breaker *c* are in the main line or circuit. The rheostat, which may be adjustable, only allows the immensely rapid pulsations from *c* to pass sufficiently upon the line to keep the same statically charged to the required extent. The transmitting-instrument *d* is in a shunt that connects with the line on both sides of the rheostat; hence the pulsations through the paper reach the line direct and increase the electric tension sufficiently to operate the receiving-instrument. The receiving-instrument *h* may be of any suitable character; but I find that there should be either an electro-magnet in a shunt-circuit to neutralize the static electricity by the counter-current as the magnet discharges, or else a battery and rheostat with the polarity of the shunt or local circuit the reverse of that of the main line. I, however, prefer to use two or more styluses or pens, *i i*, connected to the main line and to shunt-circuits, in which are placed the electro-magnets *k k*.

The tailings from the pulsations are neutralized by the reverse currents set up in the shunt-circuits as the electro-magnets discharge themselves; and by employing magnets of different powers or qualities there will be greater certainty of the record being clear and legible in one of the two or more lines of marks upon the strip of chemical paper, because the coils of the magnets are of different resisting power to vary the currents passing to the paper; and the secondary current induced in the magnet is more or less active as it is discharged.

Where a drop copy is desired it may be obtained upon the line by placing the two ends of the wires in a glass of water, *m*, and also the two poles of a local circuit, in which is a chemical-receiving instrument, *l*. By adjusting the proximity of the ends of the main-line wires to those of the local circuit the necessary division will be made for producing the record without materially interfering with the main line. At intermediate stations a branch connection, *o*, may be made to the earth with a resistance-coil, *r*, therein, and one or more of these coils may be brought into action by a switch, and these coils may form parts of electro-magnets, or a separate electro-magnet, *s*, be introduced, and a drop copy may be taken in a shunt-circuit, *t*, in this branch earth-circuit, by the electro-magnet acting upon a circuit-closing lever.

The magnet *s* may be made to operate a relay or sounder or a receiving-instrument at the local station, indicated at *u*.

I am aware that liquid rheostats or resistances have been made use of; but I am not aware that the ends of the line and of a shunt-circuit have been introduced in a liquid, and the four ends so varied or adjusted in position as to proportion the shunt and main-line currents.

I claim as my invention—

1. The resistance *b* and transmitting-instrument *d*, arranged in connection with the line, the battery *a*, and the rapid circuit-breaker *c*, as and for the purposes set forth.

2. Two or more styluses or pens connected with the main line and with shunt-circuits, in which are differing magnets for operation upon the chemical-receiving paper, as set forth.

3. The vessel of liquid receiving the two ends of the shunt-circuit and the two ends of the main line to vary the strength of the shunt-circuit according to the relative positions of such circuit ends, as set forth.

Signed by me this 12th day of December, A. D. 1872.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Chemical Telegraphs.

No. 141,774. Patented August 12, 1873.

Fig. 2.

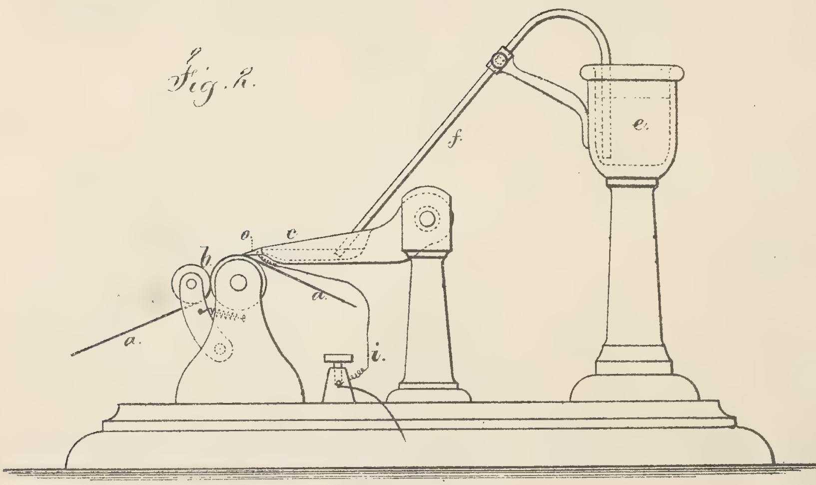
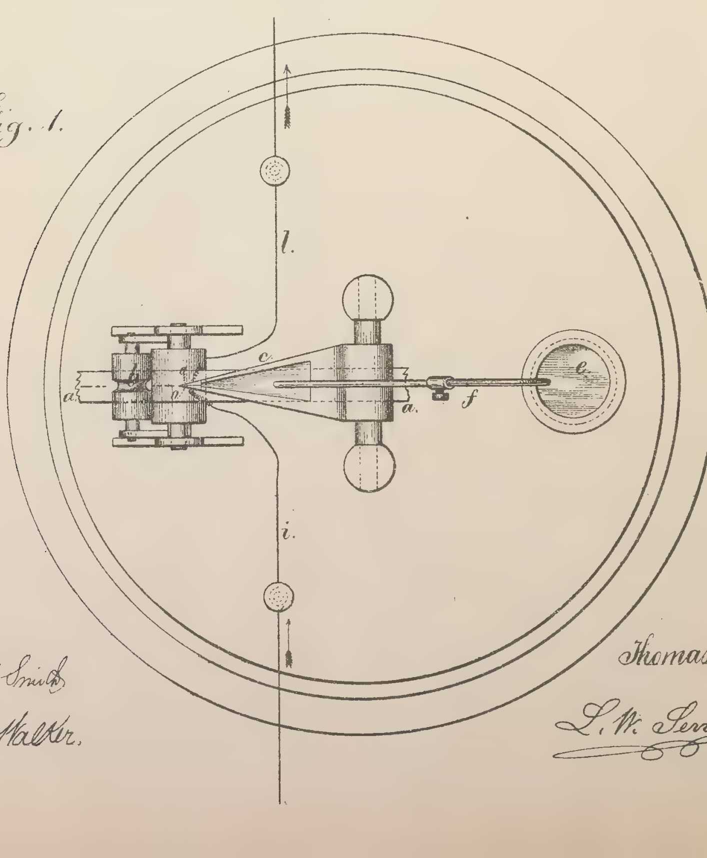


Fig. 1.



Witnesses,

Chas H Smith

Geo. B. Walker.

Inventor

Thomas A. Edison.

L. W. Serrell

atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **141,774**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Newark, in the county of Essex and State of New Jersey, have invented Improvement in Chemical Telegraphs, of which the following is a specification:

My invention relates to a chemical telegraph in which the paper is moistened as it runs through the machine, and receives the mark from the electric action upon the chemical ingredients employed. I make use of a trough or pen similar to a paper-ruling pen, and I supply to the same the chemical solution by a siphon, or otherwise, so that the strip of paper is moistened in a line immediately before or at the time that the mark is made, and the electrodes or contact-points are applied to the surface, either contiguous to the place where the liquid solution issues upon the paper, or more or less remote from the same. Thereby the decomposition of the liquid will be effected just as the same issues from the pen upon the paper, or after the solution has reached the paper and before it becomes entirely dry.

In the drawing, Figure 1 is a plan of the instrument, and Fig. 2 is a side view of the same.

The strip of paper *a* is drawn along by the rollers *b* in any of the known modes employed in automatic telegraphy. The solution is applied to the surface of the same by a ruling-pen, such as used by draftsmen, or in paper-ruling machines.

I have shown the pen *c* as a trough-shape, tapering down to the end that rests upon the paper, and into this trough the chemical solution is either placed or supplied from a fountain or reservoir, *e*, by a siphon, *f*, or otherwise.

The wires *i l*, that are in the telegraphic circuit, and through which the electric pulsations pass, are connected to two points or electrodes, *o o*, that are sufficiently close together to act upon the moist solution and decompose the same and leave the mark upon the paper, and these are placed where they will act upon the solution itself just as it issues from the pen upon the paper, or else upon such solution in the paper while it remains in a moist condition, thus insuring the proper mark and employing but a small quantity of solution.

I am aware that the strip of paper has been moistened in a narrow line by a roller immersed in the chemical solution, so as to apply the same to the paper before coming into position to receive the mark; but the paper offers a great resistance to the current, not being moistened entirely through by the time it reaches the stylus. By employing circuit-points at the surface at opposite sides of the moistened line this is avoided.

I claim as my invention—

The circuit-points or electrodes *o o*, connected with the wires *i l* and applied at each side of the line of chemical solution upon the surface of the paper, substantially as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

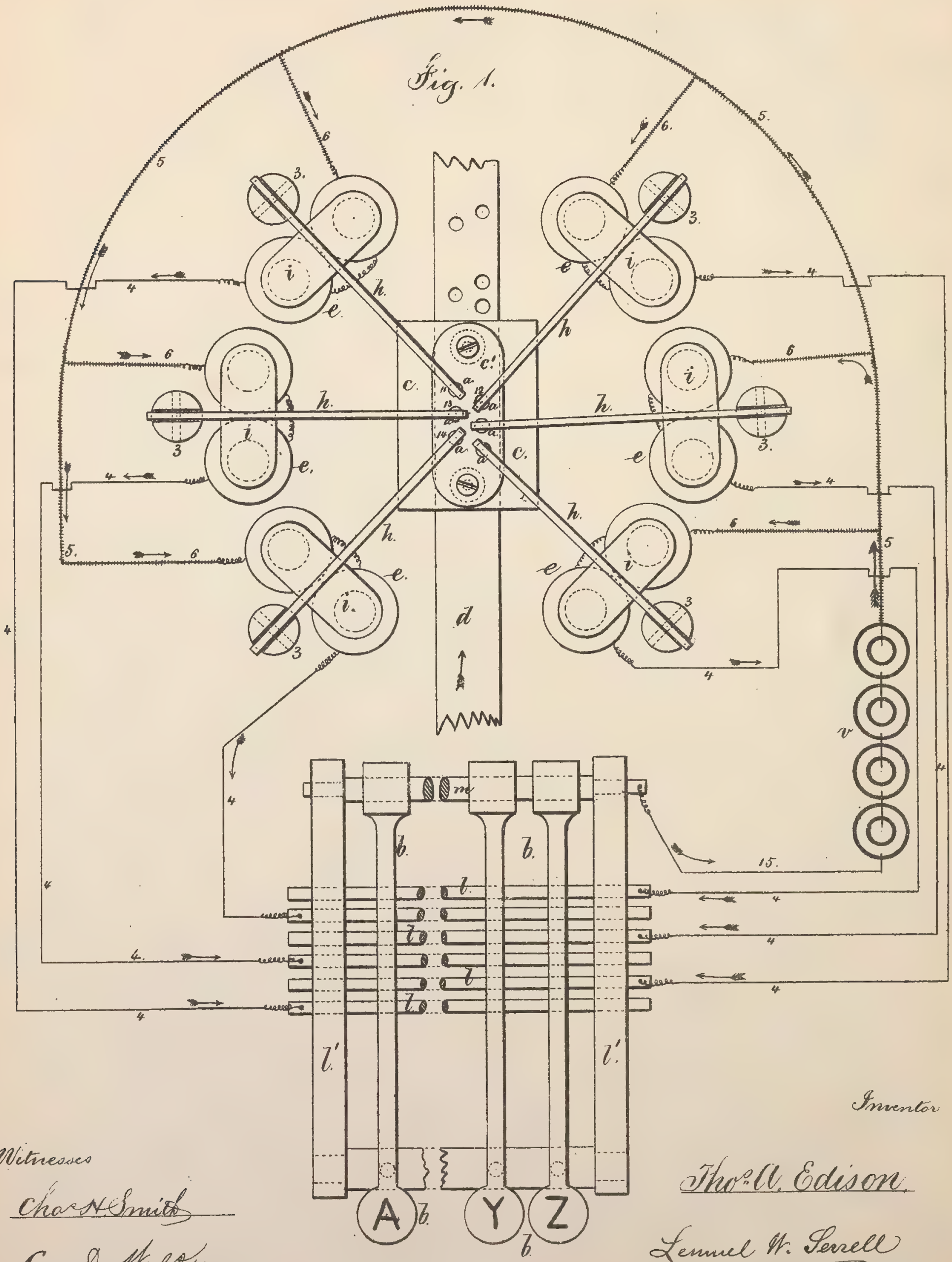
Witnesses:
Geo. T. Pinckney,
Chas. H. Smith.

2 Sheets--Sheet 1.

T. A. EDISON.

Perforators for Automatic Telegraphs.

No. 141,775. Patented August 12, 1873.



Witnesses

Chas H Smith

Geo. D. Walker.

Inventor

Thos. A. Edison.

Lemuel W. Serrell Atty

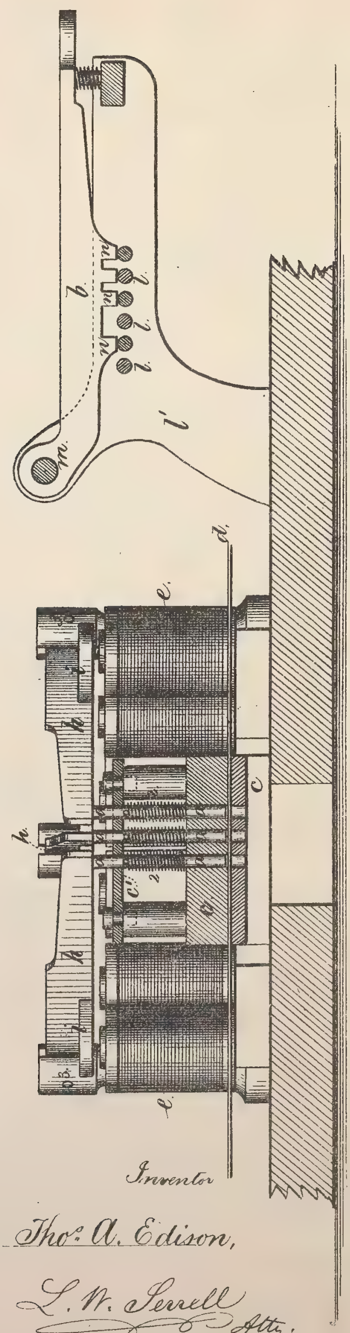
2 Sheets--Sheet 2.

T. A. EDISON.

Perforators for Automatic Telegraphs.

No. 141,775. Patented August 12, 1873.

Fig. 2.



Inventor

Witnesses

Chas H Smith

Geo. D. Walker.

Thos. A. Edison,

L. W. Serrell Atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN PERFORATORS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,775**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Machines for Perforating Paper for Use in Automatic Telegraphy, of which the following is a specification:

In Letters Patent No. 121,061, granted to me, a device is shown for perforating paper in which the punches are moved by power applied to finger-keys acting through cams and slide-bars.

My present invention relates to employing electro-magnetism as the motor to project the punches, so as to render the work of operating the machine less fatiguing to the hand and arm of the operator than if the power to move said punches is applied by the hand to the keys; and by this improvement I dispense altogether with the cams and slide-bars of aforesaid patent.

I employ an electro magnet or magnets to actuate each punch through an armature and lever, and the connections to the magnets are arranged so that by depressing a finger-key the circuit is closed to the proper magnet or magnets, and they, by their levers, move the punch or punches, and the paper is perforated with the character corresponding to that of the depressed finger-key.

In the drawing, Figure 1 is a plan, and Fig. 2 is a vertical section, of my improved machine.

a a represent the punches (and of these there should be ten) for making the characters composing the Morse alphabet. I have shown but six to avoid duplication of parts, and for the same reason only three keys of the horizontal range of finger-keys *b b* are represented. The punches *a a* are placed in two rows, and move vertically in the die *c* and guide-plate *c'*, and are kept raised from off the strip of paper *d* by the springs 2 2 when not acted upon by the levers *h h* of the electro-magnets *e e*.

The paper is drawn through an opening in the die *c*, beneath the punches, by any suitable feeding device; but, as this forms no part of my invention, it is not represented in the drawing.

The electro-magnets *e e* for actuating the punches are supported upon the bed of the machine, and are preferably arranged in a circle, with their levers *h h* radiating from the group of punches, as shown in Fig. 1, so as to economize space and allow of said levers acting upon their respective punches without risk of interfering with each other. Each lever is provided with an armature, *i*, and moves upon a fulcrum, 3; and said lever may either rest upon its punch *a* or be connected to it by a pin and slot. Beneath the range of finger-keys *b b* there is a range of metallic bars or rods, *l l*, supported and insulated in the frames *l' l'*; and there is the same number of bars *l* as there are punches *a*. Each bar *l* is in metallic connection with its magnet *e* by the wire 4, and the battery *v* is connected to all the magnets *e* by the wire 5 and branches 6 6. The finger-keys *b b* are pivoted upon the rod or shaft *m*; and upon the under side of each key there are one or more projections, *n*, each contiguous to a bar, *l*; and these projections are different in number and position upon the various keys, and arranged so that when a key is depressed and its projections in contact with the bars *l* the circuit is closed to such magnets *e* as actuate those punches that produce a character corresponding with that of the depressed key. Thus the key shown depressed in Fig. 2 is provided with four projections, *n*, and the circuit is closed to the four magnets that actuate the punches marked 11, 12, 13, and 14, and the character made is three perforations in one line and one in the other line, the whole representing a long dash and dot.

When a key, *b*, is depressed the current from the battery *v* passes to the magnet or magnets *e e* by the wire 5 and branch or branches 6 6, and from said magnets, by the wire or wires 4, to the bar or bars *l*, finger-key *b*, shaft *m*, and wire 15, back to the battery.

By this arrangement of mechanism the punches are operated by the power of electro-magnets, and the finger-key only performs

the duty of closing the circuits through said magnets.

The arrangement of the electro-magnets may be varied, and they may be more or less direct acting upon the punches, and positioned according to the arrangement and number of the punches.

I claim as my invention—

A group of punches for perforating telegraphic paper, actuated by a separate electro-magnet to each punch, in combination with the circuit-bars *l* and a range of finger-keys, for selecting the circuits that are to be closed to perforate the paper in accordance with the character upon the key, substantially as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

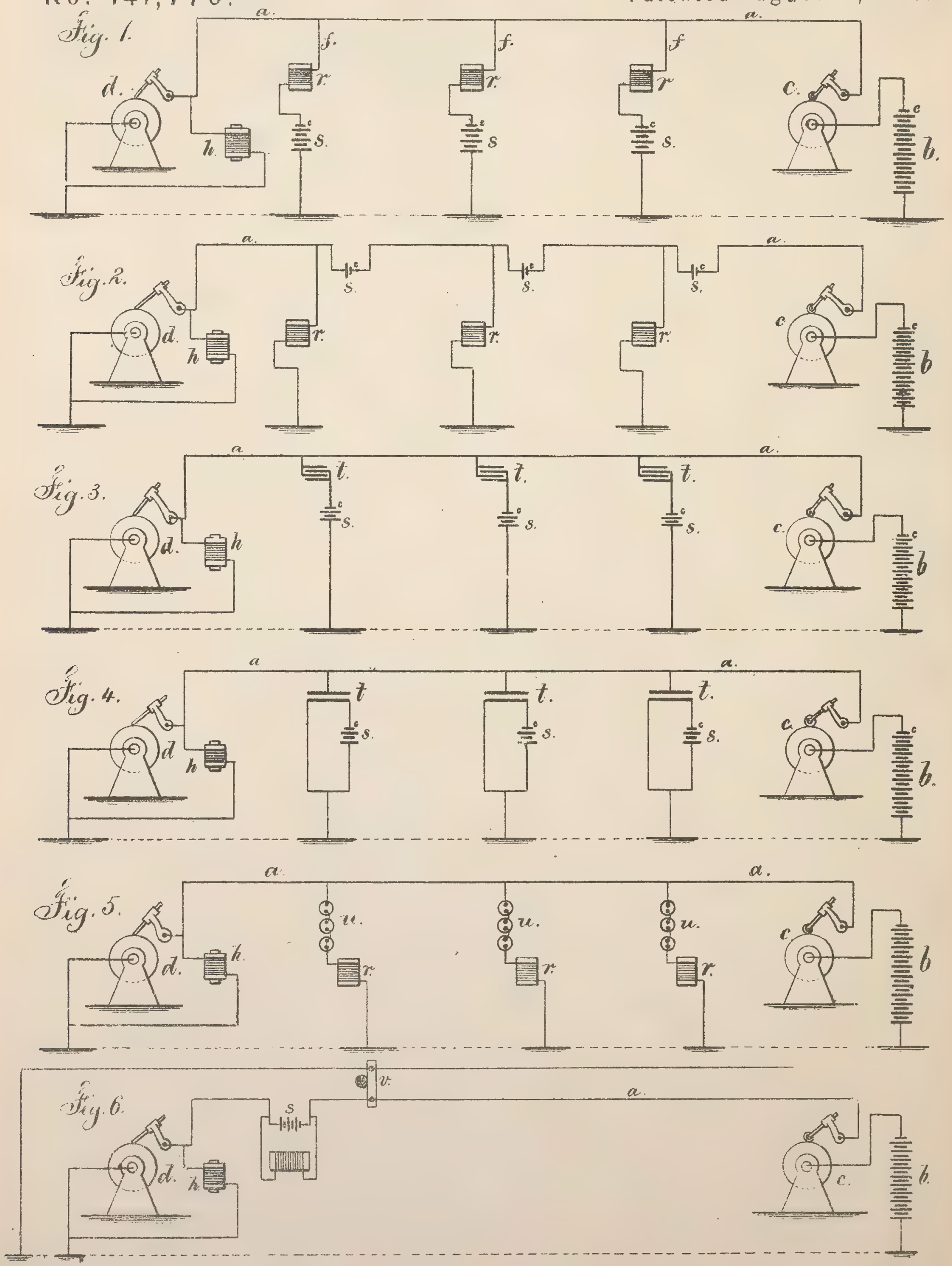
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Circuits for Automatic Telegraphs.

No. 141,776. Patented August 12, 1873.



Witnesses, Chas H. Smith, Geo. T. Pinckney

Inventor, Thomas A. Edison, Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN CIRCUITS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **141,776**, dated August 12, 1873; application filed January 15, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

In automatic telegraphing the speed of the pulsations is such that the line becomes surcharged, and the mark upon the chemical paper is attenuated to such an extent that one mark runs into another, or dots appear like dashes. The chemical paper is now made very sensitive, and a very feeble current is sufficient for making the mark; but in long lines the difficulty in clearing the line of the static electricity has been so great as to reduce the speed of transmission in order to obtain legible characters.

My present invention has been devised and successfully employed for effecting the clearing of the line without injury to the transmission of the pulsations.

Leaks and ground-connections have before been employed. My invention, therefore, does not relate thereto.

I make use of a battery, or a number of batteries, at a distant station, or distributed along the line, such battery or batteries being much weaker than the sending-battery, and connected in such a manner to the main line as to direct upon the same a current of opposite polarity, which has to be overcome by the pulsations from the sending-station; but these are always sufficient, and the slight reverse current, acting in detail upon the line-wires, keeps them free from any attenuation in the transmitting pulsations, thereby increasing the rapidity of automatic telegraphing, especially on long lines, and rendering the writing clear and sharp.

In the diagrams on the drawing, *a* represents the line; *b*, the transmitting-battery; *c*, the transmitting-instrument; and *d*, the receiving-instrument. In the former a strip of perforated paper and stylus are employed; in the latter a strip of chemical paper and a stylus.

In Figure 1 there are several branch circuits, *f*, in which are placed rheostats or resistances *r*, that may be adjustable, and also batteries *s*, that are of the proper power, and placed with the opposite pole to the line to that of the battery *b*, so that the line is operated upon in detail, at suitable distances apart—say every one hundred miles, more or less—and the line freed from tailing; and the same is opposed to the main current, but not sufficiently powerful to neutralize the same or to interfere with the transmission. These batteries *s* are so proportioned or adjusted as to be equal to the static electricity or current generated by the passage of the main current. The rheostats or resistances *r* are sufficient to prevent the battery *b* being short-circuited through the various branch-circuit connections to the earth, and to cause the proper proportion of said battery-current to reach the receiving-instrument.

In Fig. 2 the same parts are employed; but the opposition batteries *s* are placed in the main line, and distributed along the same. The branch circuits to the earth, with resistances, act with the local opposition batteries to establish currents counter to the main current.

In Fig. 3 the effect produced is the same as before described; but in place of rheostats there are condensers *t*, and the opposition local batteries *s*, acting upon the condensers, establish an opposite polarity on the plates of the condenser that are connected with the line to the polarity of such plates when influenced by the transmitting-battery, thereby neutralizing the tailings by charging the line statically in opposition to that from the main current.

The condensers may be connected with the opposition local batteries, in the manner seen in Fig. 4, so that the plates that are connected to the line-wire will also be connected to one pole of the battery, and the other plates of the condenser will be connected with the earth and the other pole of the battery, the operation being similar to that before set forth.

In Fig. 5 the parts are the same in their operation as those before described; but instead of ordinary batteries, cups *u*, containing platina or carbon strips and acidulated water, are employed, so that when the pulsation on the main line ceases to charge such cups a momentary reverse current is established to neu-

tralize the tailing by instantly freeing the line of any electric charge.

In Fig. 6 the line-battery *s* is introduced at the receiving-station, to neutralize any local current that may leak from one insulator to another upon the poles *v*, and tend to charge the line sufficiently to produce a light continuous mark upon the paper, the battery *s* not being sufficient to interfere with the pulsations for the message, although its poles are opposed to the same.

The electro-magnets, at *h*, are in a shunt, connected at both sides of the receiving-instrument, to neutralize any tailings at the instrument, as in my application No. 61, dated November 9, 1872.

I claim as my invention—

The use of an opposition or secondary battery of weak power at one or more points, to act in the main line in opposition to the pulsations from the transmitting-instrument, to free the main line of surplus or static electricity, substantially as set forth.

Signed by me this 12th day of December, 1872.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

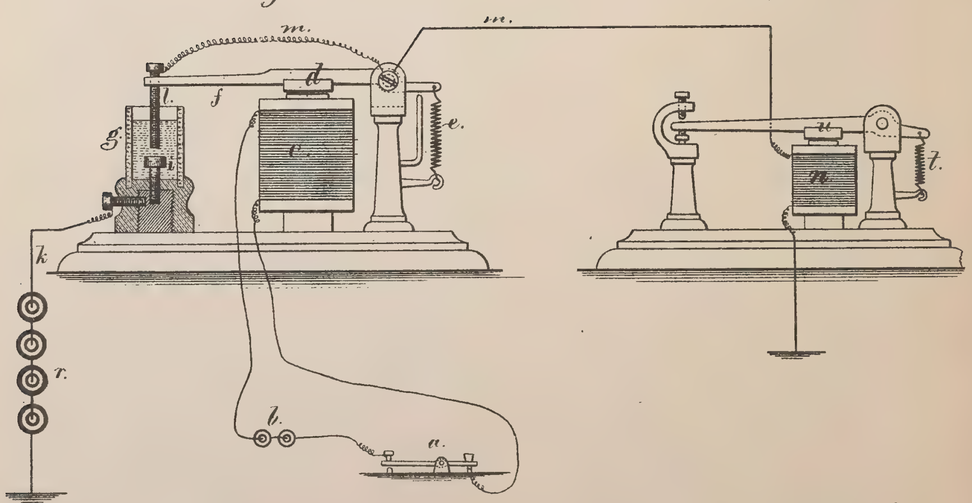
Relay Magnets.

No. 141,777.

Patented August 12, 1873.

Fig. 1.

Fig. 2.



Witnesses, Chas H Smith
Geo. D. Walker.

Inventor
Thomas A. Edison
Lemuel W. Serrell
atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN RELAY-MAGNETS.

Specification forming part of Letters Patent No. **141,777**, dated August 12, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Instruments, of which the following is a specification:

Relay-magnets are employed to a large extent in various telegraphic operations. It is, however, found that the adjustment of the springs that draw back the armature and the burning of the contact-points by the spark are sources of constant annoyance.

My present invention is made for preventing the points burning out, and for avoiding adjustment of the retractile armature-springs.

I make use of metallic contact-points within a liquid, such as glycerine or water, so that the motion of one contact-point nearer to or farther from the other raises and lowers the electric tension in the telegraph-line, and operates a distant magnet without forming a spark or breaking the circuit.

In the drawing, Figure 1 is a side view of the relay-magnet with the circuit-cup in section, and Fig. 2 is a side view of the distant magnet.

The finger-key *a* is in a circuit from the battery *b;* so also are the coils of the relay-magnet *c*. The armature *d* and its lever *f* are moved by the spring *e* in one direction, and by the magnet *c* in the other. The circuit-cup *g* is made to contain water, glycerine, or other suitable liquid. In the bottom is the screw or point *i*, connected with the circuit-wire *k*, and the movable point or screw *l* passing through the lever *f* is connected with the other circuit-wire *m*, extending to the distant magnet *n*. The battery *r* is in the circuit to the magnet *n;* and it will now be understood that by adjusting the point *l* nearer to or farther from *i* the proportion of current passing to the magnet *n* can be adjusted so that, when the point *l* is moved by the magnet *c* nearest to *i*, the current from *r* will be sufficiently powerful to energize the magnet *n* and draw down its armature *u;* but when the circuit to the magnet *c* is broken at the key *a*, or otherwise, the movement of the point *l* away from *i* will lessen the tension in the circuit *k m* by the resistance of the intervening liquid, and weaken the power of the electro magnet *n*, so that its spring or weight *t* will draw away its armature.

The movement of the armature *u* may be made operative in effecting any desired telegraphic operation to which it is adapted. I, however, employ the same especially as a sounder, and in that case the battery *r* and circuit *k m* are local.

I am aware that contact-points within a liquid, such as oil or glycerine, have been employed in the circuit-breaker of an electric engine. In my improvement the circuit is not broken, but the relay-magnet or sounder is operated by rise and fall of tension, and the contact-points are adjustable instead of varying the armature-spring of the magnet.

I claim as my invention—

The adjustable contact-points acting within a liquid, in combination with the helix, armature, and spring of a sounder or relay, as set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Electrical Regulators for Transmitting Instruments.

No. 142,688. Patented September 9, 1873.

Fig. 2.

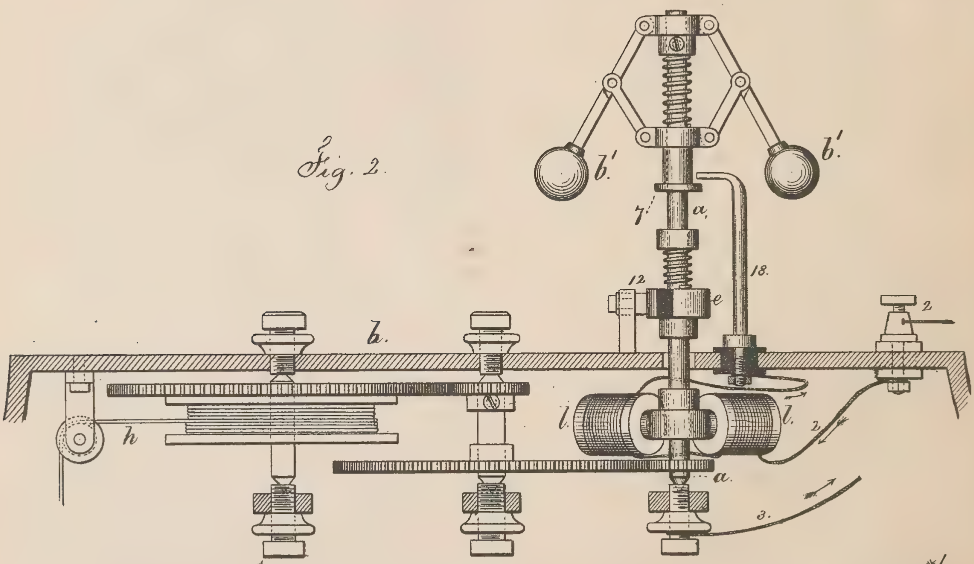
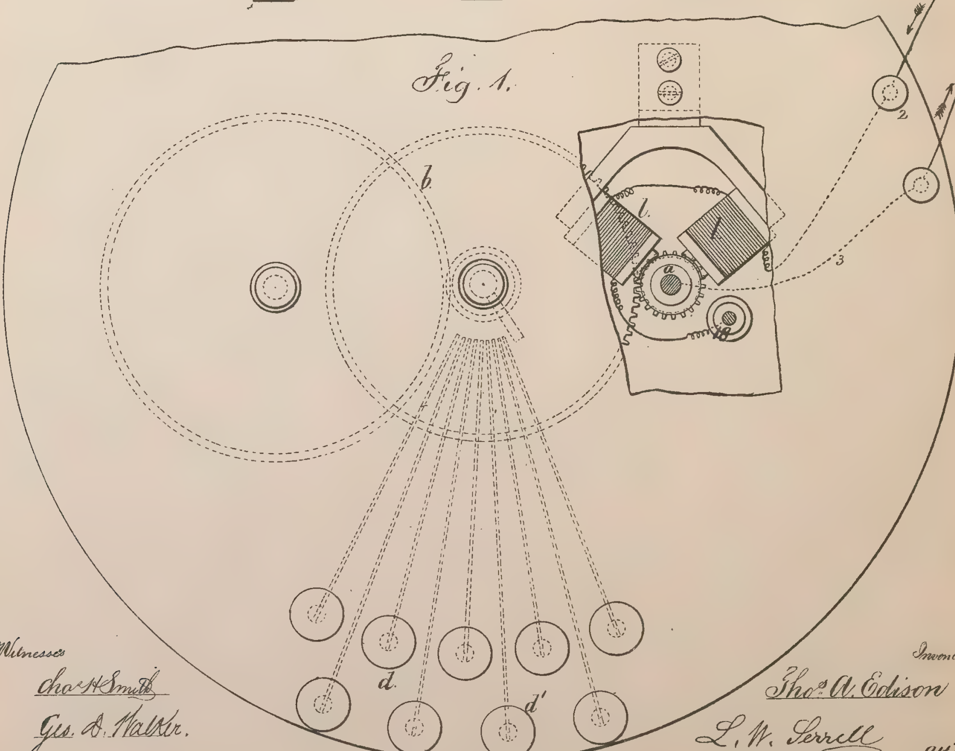


Fig. 1.



Witnesses

Chas H Smith

Geo. D. Walker.

Inventor

Thos A. Edison

L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRICAL REGULATORS FOR TRANSMITTING-INSTRUMENTS.

Specification forming part of Letters Patent No. **142,688**, dated September 9, 1873; application filed March 13, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Transmitting-Instruments, of which the following is a specification:

This invention relates to means for regulating the speed of the pulsator-shaft in that class of transmitting-instruments in which said shaft is revolved by an electromotor, weight, or spring.

My improvement consists in employing an electro-magnet with its cores contiguous to the pulsator-shaft to check the speed of said shaft when it exceeds its maximum or determined rate by the magnetism of the cores attracting said shaft and retarding its movement.

The circuit to the electro-magnet is closed by the governor on the shaft rising by the increase of speed and bringing a flanged sleeve in contact with an insulated post, and opened when their contact is broken by the slight diminution in speed of the shaft, and consequent fall of the governor and its sleeve, when the electro-magnet ceases its action upon the shaft.

In the drawing, Figure 1 is a plan, and Fig. 2 is a section of part of a transmitting-instrument sufficient to illustrate my improvement.

b represents the bed of the instrument, and beneath this is a train of gearing for revolving the pulsator-shaft *a*, said gearing being operated by a weight at the end of the cord or rope *h*; or my improvement is equally available where the pulsator-shaft is revolved by an electromotor, or by a spring and gearing.

The pulsator *e* upon the shaft *a* acts with the circuit-closing lever or spring 12 to open and close the main-line or local circuit, as in my patent No. 131,343, and a reference is hereby expressly made to the same for the action of this pulsator, and for the construction and operation of the finger-keys *d d'*, shown by dotted lines in Fig. 1, as the aforesaid patent sets these parts forth and the objects accomplished.

The electro-magnets *l* for regulating the speed of the shaft *a* are placed with their cores contiguous to an iron or steel hub on said shaft, as shown in Fig. 1, and the enlargement of the shaft at this point gives ample metallic surface for the magnetism of the cores to act upon. These magnets *l* are in a local circuit, 2 3, connected with the shaft *a*, and also to the insulated post 18. *b'* is the governor revolving with the shaft *a*, and provided with a sleeve, upon which is a flange, 7, as in aforesaid patent. As the governor rises by increase of speed, the flange 7 comes in contact with the end of the insulated post 18, and closes the circuit to the magnets *l*, which, by their attraction upon the shaft *a*, retard its speed. This slight diminution of speed causes the governor-ball to fall and breaks the circuit at 7 18, and upon the speed again increasing the circuit is again closed by 7 and 18 coming in contact, and the speed is checked, as before.

In the aforesaid patent the contact of 7 and 18 by increased speed lessens the current to the motor. In the present instance the magnetic brake formed by the magnets *l* checks the speed. The cores of these magnets might be loose within the helices; or the magnets might be upon a spring-arm, so as to be brought into contact with the shaft by the attraction, if desired.

I claim as my invention—

The speed-regulator consisting of the electro-magnet *l*, shaft *a*, and governor, in combination with the circuit-closer and pulsator, substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Galvanic Batteries.

No. 142,999. Patented September 23, 1873.

Fig. 1.

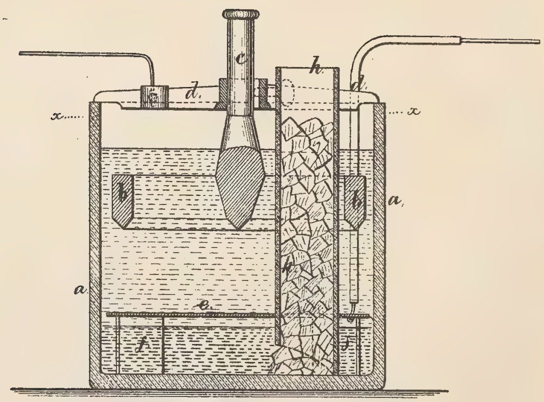
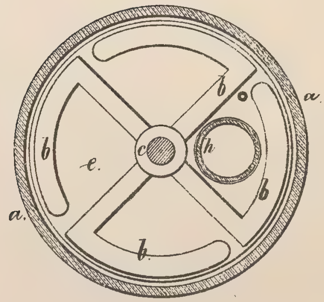


Fig. 2.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN GALVANIC BATTERIES.

Specification forming part of Letters Patent No. **142,999**, dated September 23, 1873; application filed November 5, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Galvanic Batteries, of which the following is a specification:

Galvanic batteries have been made with a plate of copper at the bottom of the glass jar in which the zinc is suspended. The zinc has been attached adjustably by arms, and the copper in some instances has been a plate placed edgewise in the bottom of the cell. In all instances the sulphate of copper has been placed around and above the copper plate, and in practice it is found that the zinc becomes discolored and its efficiency is injured by a coating or deposit from the blue vitriol. I have discovered that when the sulphate of copper is placed below the copper pole of the battery the zinc pole will remain more efficient and free from deposit, that the blue-vitriol solution in the liquid of the cell will not extend above, or but little above, the copper plate, and that the battery will not require replenishing as rapidly as now usual, and will remain at a more uniform intensity.

In the drawing, Figure 1 is a vertical section, and Fig. 2 is a sectional plan, at the line *x x*, of my said battery.

The cup or cell *a*, zinc *b*, suspending-rod *c*, arms *d*, and clamp are to be of any usual character.

In carrying out my improvement, I support or suspend the copper pole *e* at a short distance from the bottom of the cell, say one inch, more or less. To effect this, the copper pole may have legs, *f*, resting upon the bottom of the cell, or the same may be suspended by non-conducting material, such as hard rubber, from the edges of the vessel *a*, or from the zinc pole or its support. The sulphate of copper is to be supplied below the copper pole, either by inserting the same before introducing the copper, or it may preferably be supplied through the tube *h* that passes by the copper pole, so that the sulphate of copper introduced through the same remains below the copper and the metallic copper is deposited, and the zinc is acted upon by the acid that is liberated without the deposit of foreign matter resulting from the direct contact of the sulphate of copper with the zinc.

I do not claim a copper pole resting on short projections that serve to keep the same above any impurities in the cell.

I claim as my invention—

The arrangement, in a galvanic battery, of the horizontal copper plate above the sulphate of copper and its solution, and below the zinc pole and the liquid surrounding the same, for the purposes and substantially as set forth.

Signed by me this 31st day of October, A.D. 1872.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telegraph Signal-Boxes.

No. 146,812. Patented Jan. 27, 1874.

Fig. 1.

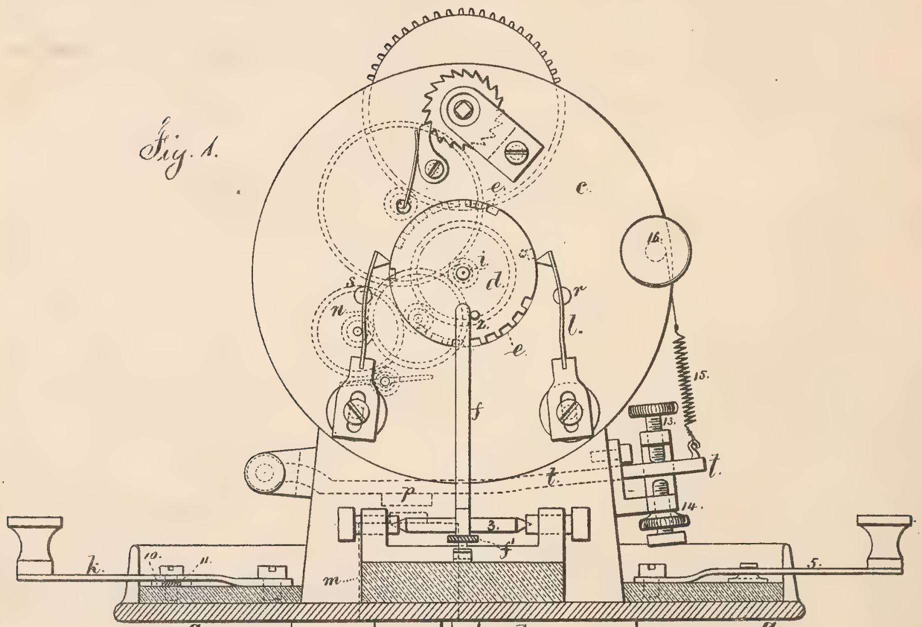
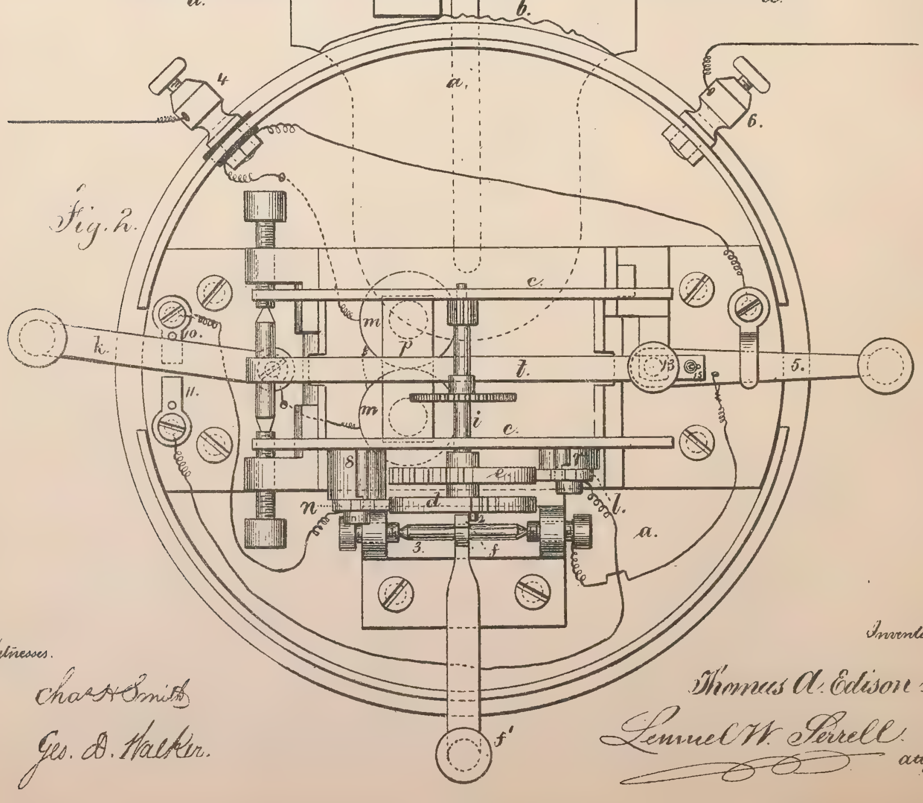


Fig. 2.



Witnesses.

Chas H Smith

Geo. D. Walker.

Inventor

Thomas A. Edison.

Lemuel W. Serrell

atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO AMERICAN DISTRICT TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEGRAPH-SIGNAL BOXES.

Specification forming part of Letters Patent No. **146,812**, dated January 27, 1874; application filed December 3, 1872.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Alarm and Signal Apparatus, of which the following is a specification:

Before my invention, an alarm apparatus and local telegraph had been invented for communicating from several houses or buildings in a telegraphic circuit with the central station, for calling police, messenger, or other service, as seen in Letters Patent No. 127,844, granted to E. A. Calahan. My invention is an improvement upon the same, and a modification of Letters Patent No. 129,526; and consists in an adjustment to the springs that close the circuit, whereby the V-shaped ends are properly positioned, and the power of the springs regulated. Also, in arranging the magnet, armature, and adjustable stops in relation to the clock-work so that the parts are easy of access, and the sound from the moving armature will be unconfined.

In the drawing, Figure 1 is an elevation with the bed in section; and Fig. 2 is a plan with the clock-work or train of gearing removed.

The base *a* is made circular, and adapted to receiving a glass shade to protect the machine from dust; and the base is sustained by a bracket, *b*, that can be screwed to a window or door frame, or other convenient support. The plates *c c* are connected to the base *a*, and carry the spring-barrel and train of gearing, of any usual character, to rotate the shaft *i* and brake-wheels *d* and *e*. There is a stop-pin, 2, upon the wheel *d* that is arrested by the lever *f*, which lever *f* is mounted upon the insulated cross-shaft 3, and provided with a finger-key, *f′*, ouside the base, so that, by depressing the said key *f′* the lever *f* is moved, the pin 2 liberated, and the train of gearing allowed to move, and revolve the wheels *d* and *e*. The same movement breaks the electric circuit that ordinarily passes from the binder 4, through the insulated switch 5 and wire, to the lever *f*; thence, through the pin 2 and clock-work and bed, to the binder 6.

In the brake-wheels *d e* are notches, positioned to give indications upon a suitable instrument at the central receiving-station—such as a bell-magnet, armature, and hammer—to designate, by the strokes on the bell, the number allotted to the wheel *d*, or to the wheel *e*, and, in so doing, indicate the station at which the instrument is placed containing such numbers; and, also, what is wanted—such as police or messenger.

The switch *k* is employed to direct the circuit through either the wheel *d* or the wheel *e*, according to what is to be indicated at the receiving-station. I remark that the contact-blocks 10 and 11 of the switch are sufficiently near each other for the circuit not to be broken in the act of moving the switch from one contact-block to the other.

The circuit-closing springs *l n* are upon insulated blocks, and connected by clamping-screws passing through slots, so that the V-shaped ends of such springs can be adjusted in their position vertically; and also in the force with which they press against the respective wheels *d* or *e*. There are insulated stops *r s* provided to limit the movements of the springs *l n*, and prevent the V-ends of the springs moving too far into the slots in the circuit-wheels *d e*, thereby insuring the proper length of pause between the pulsations.

The electro-magnet *m* is in an opening in the base *a* below the clock-work, and it is provided with an armature, *p*, and lever *t*, having a limited motion between the adjusting-screws 13 14, and the retractile spring 15 is adjusted by the shaft 16, that passes through the frames *c*. This arrangement renders the parts very compact, gives access to the magnet from below, and brings the moving end of the armature-lever where it can be seen, and the sound thereof against the screws 13 14 will not be confined.

The connection from the binder 4, through the insulated switch 5 to the lever *f*, ordinarily remains closed, and forms a shunt to the main line, cutting out the electro-magnet; but, when broken at 5, the current is compelled to go through the electro-magnet *m*, producing a motion of the armature, and sound. This switch 5 is, therefore, only employed by an operator

to ascertain whether or not the line is in use by any other instrument, by compelling any pulsation to pass through his magnet, and if the electro-magnet is not vibrated the line is clear, and his own instrument can be started, and, by the electro-magnet responding, it will become apparent that the line is in proper condition.

I claim as my invention—

1. The circuit-springs *l n*, attached by slots and screws, so as to be adjustable in their length and power, as set forth, in combination with the wheels *d e*, as specified.

2. The combination of the electro-magnet *m* beneath the clock-work, the adjusting armature-lever, screws 13 14 outside the clock-work, and the shaft 16, for adjusting the spring 15 above the lever and through the clock-plates *c c*, all arranged as and for the purposes set forth.

Signed by me this 26th day of November, 1872.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Electric-Telegraphs.

No. 147,311. Patented Feb. 10, 1874.

Fig. 1.

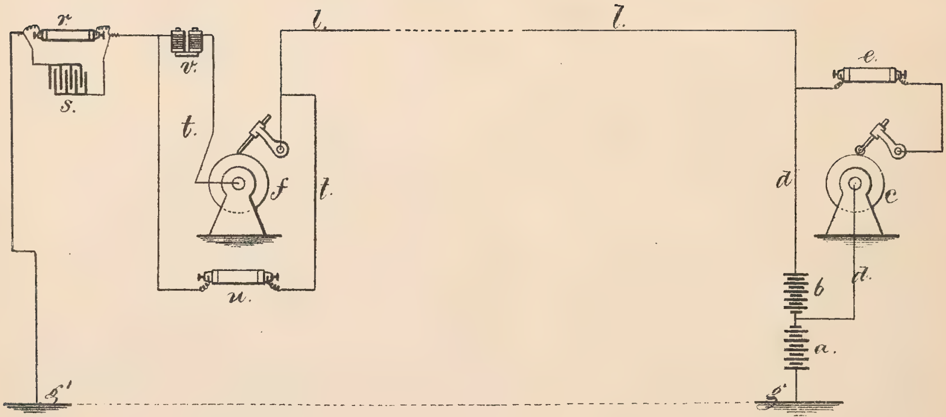


Fig. 2.

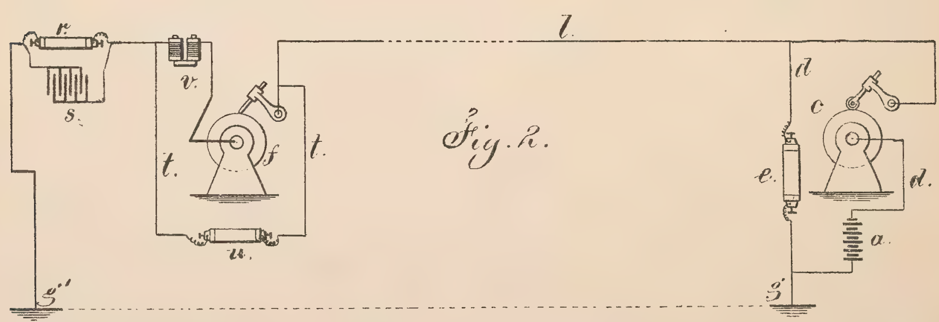
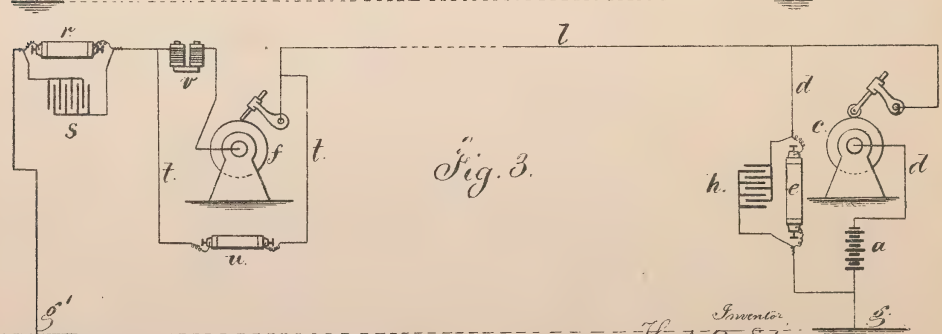


Fig. 3.



Witnesses

Chas. H. Smith

Harold Serrell

Inventor

Thos. A. Edison,

per Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **147,311**, dated February 10, 1874; application filed July 29, 1873.

CASE 82.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Electric Telegraphs, of which the following is a specification:

In cables and long telegraph-lines there is a limit to the speed with which perfect signals can be transmitted and received, whether the receiving-instrument consists of an electro-magnet, a galvanometer, a relay, or a chemical-telegraph instrument. This limit in speed arises from the fact that the moment the line or cable is charged by the battery being connected, a static charge is instantly set up, which is in an opposite direction to the dynamic charge, and the tendency is to defer the reception of the signal at the distant station, and at the moment of breaking the battery-connection, the static charge disperses by dividing at the center of resistance, and going in both directions, one part going to the ground at the transmitting station in a direction opposed to the battery, and the other part going toward the receiving-instrument in the same direction as the previous current from the battery. This electrical condition is of sufficient duration to render the signals unintelligible at the receiving-instrument after a certain speed is attained. The time of discharge is directly proportioned to the resistance at the points of discharge at the ends of the line, and the result is that the speed of the instruments is limited to the speed with which the line will free itself through the channels aforesaid.

My invention relates to the discovery of a method of neutralizing the effects of the static charge in any length of line or cable, by balancing the electric forces, and the discovery of a point of no electric tension or zero, as regards the static charge, so that the receiving-instrument, when located at that point, will be operated by the rise of tension produced by a pulsation that is connected at such receiving-instrument, and made as instantly and definitely operative as the pulsation given at the transmitting station.

I obtain this point of no tension by forming at the receiving end an artificial line, having an equal or nearly equal resistance and electro-static capacity, or capacity for producing static charges, as that of the cable or land line, and connect this with the line or cable, and place between the cable and the artificial line the receiving-instrument, which hence is in the center of resistance and static accumulation. When this balance is obtained, the signals are received perfect, and the rapidity is governed only by the strength of the battery.

The artificial line is made with an adjustable rheostat; liquid in a tube is preferable. I connect, between the receiving-instrument and the earth, one or more condensers, or other accumulators of static electricity, which are made adjustable by having them in sections, and bringing one or more sections in or out by a switch, so as to increase or decrease the static charge from the artificial cable. It may also be done by placing a very high adjustable resistance-coil between one leaf of the condenser and the artificial line. I maintain a very low resistance between the line and the ground at the transmitting station, so as to discharge the static current at this end as rapidly as possible.

The mode which I prefer is to keep my transmitting-battery in circuit at all times, and include in the same circuit another battery of equal power with opposite poles, so that, when both are in, there is no current generated, and the resistance of the wire to earth is no more than the resistance of the battery. The transmission of a pulsation is made, when the circuit is closed, through the perforation in the paper, or otherwise, so as to short-circuit or shunt the neutralizing battery, and send a current upon the line. The current at the receiving-paper is shunted through a resistance, so as to preserve a constant and equal resistance, which the chemical receiving-paper does not give, owing to being more damp in one place than another. In balancing the resistance and static current, the resistance of the instrument is to be added to the line, and the resistance of the two equalized by the

same amount of resistance in the artificial cable or line. If the receiving-instrument is out of the center of resistance toward the line, the pulsations will be weakened by the static charge acting against the pulsation; but if the instrument is toward the artificial cable on the other side of the zero-point, the signals or characters will be slightly prolonged, owing to the static charge discharging in the same direction as the current. It is at this point that I prefer to place the instrument, because, by placing an electro-magnet in the shunt of the receiving-instrument, I obtain enough counter-discharge from that magnet to cut off this prolongation locally, and this discharge from the magnet will not interfere with the line, but has only a local effect on the receiving-instrument to prevent tailing on the chemical paper.

In the drawing, Figure 1 illustrates my invention in the form that I find most generally available. The batteries *a* and *b* are connected in opposite positions, the positive poles being toward each other, and the negative poles connected to the ground *g* and line *l*, respectively. The transmitting-instrument *c* is in a circuit, *d*, to the battery *b*, in which circuit *d* is a resistance, *e*. When the circuit *d* is broken, the two batteries *a b* neutralize each other, and there is no charge sent on the line; but when the circuit *d* is closed through a perforation in the paper, or by a key, or otherwise, the battery *b* is short-circuited, and the battery *a*, being unbalanced, sends a pulsation on the line. The artificial line between the receiving-instrument *f* and the earth *g'* is made by introducing a resistance or rheostat at *r*, preferably a tube containing liquid, with adjustable points. This rheostat is made to balance or equal, or nearly so, the resistance of the line *l*, and the instrument *f* and the condenser *s*, or other accumulator of static electricity, is of a capacity to about equal that of the line; hence the receiving-instrument will occupy a zero or neutral point in regard to the static charge, from which the static charges will discharge both ways to *g* and *g'*. The condenser or accumulator *s* should be in sections, to bring in a greater or less number of sections by switches. When the receiving-instrument is chemical, the paper is preferably prepared by dipping it in a solution of at least one pound of iodide of potassium in one gallon of water, to which is added a small quantity of flour. This paper cannot be maintained at uniform moisture; hence its resistance to the passage of electricity varies. This is compensated for by the shunt-circuit *t*, in which is a resistance, *u*, sufficient to direct the necessary amount of electricity to the paper to make the mark, and allow the remainder to pass to the artificial line. Thus the varying condition of the paper does not change the resistance of the line.

I have discovered that when an electro-magnet is energized, and the circuit broken, a pulsation is set up in the opposite direction to that passing into such magnets. I avail of this to prevent tailing upon the chemical paper, and at *v* I have shown an electro-magnet for this purpose. It will be seen that this electro-magnet will discharge itself within a short local circuit containing the receiving-instrument, and that the reactionary current therefrom, moving in the opposite direction to the main current, frees the receiving-instrument from the tailing caused by the discharge of static electricity, and this magnet *v* may be employed in many places to effect the object before named, even when there is not an artificial line. In some instances with very long lines, there may be intermediate artificial lines, arranged as aforesaid, or reactionary magnets with branch circuits to the earth, to either receive drop copies in such branch circuits or to free the line of static electricity, and aid in obtaining the signals perfectly at the last receiving station with the greatest rapidity. Figs. 2 and 3 represent the same parts as before described; but in Fig. 2 only a single battery is shown, and the resistance *e* is between the line and the earth, to regulate the proportion of electricity sent over the line, by adjusting such rheostat to prevent too great return to the battery through such rheostat. In Fig. 3 a condenser, *h*, is introduced in addition to this rheostat, that it may react between the pulsations of electricity on the main line to aid in clearing such line of the static charge.

I claim as my invention—

An artificial line between the receiving-instrument and the earth, to balance the resistance and static charge, or nearly so, at both sides of the receiving-instrument, substantially as set forth.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. D. WALKER,

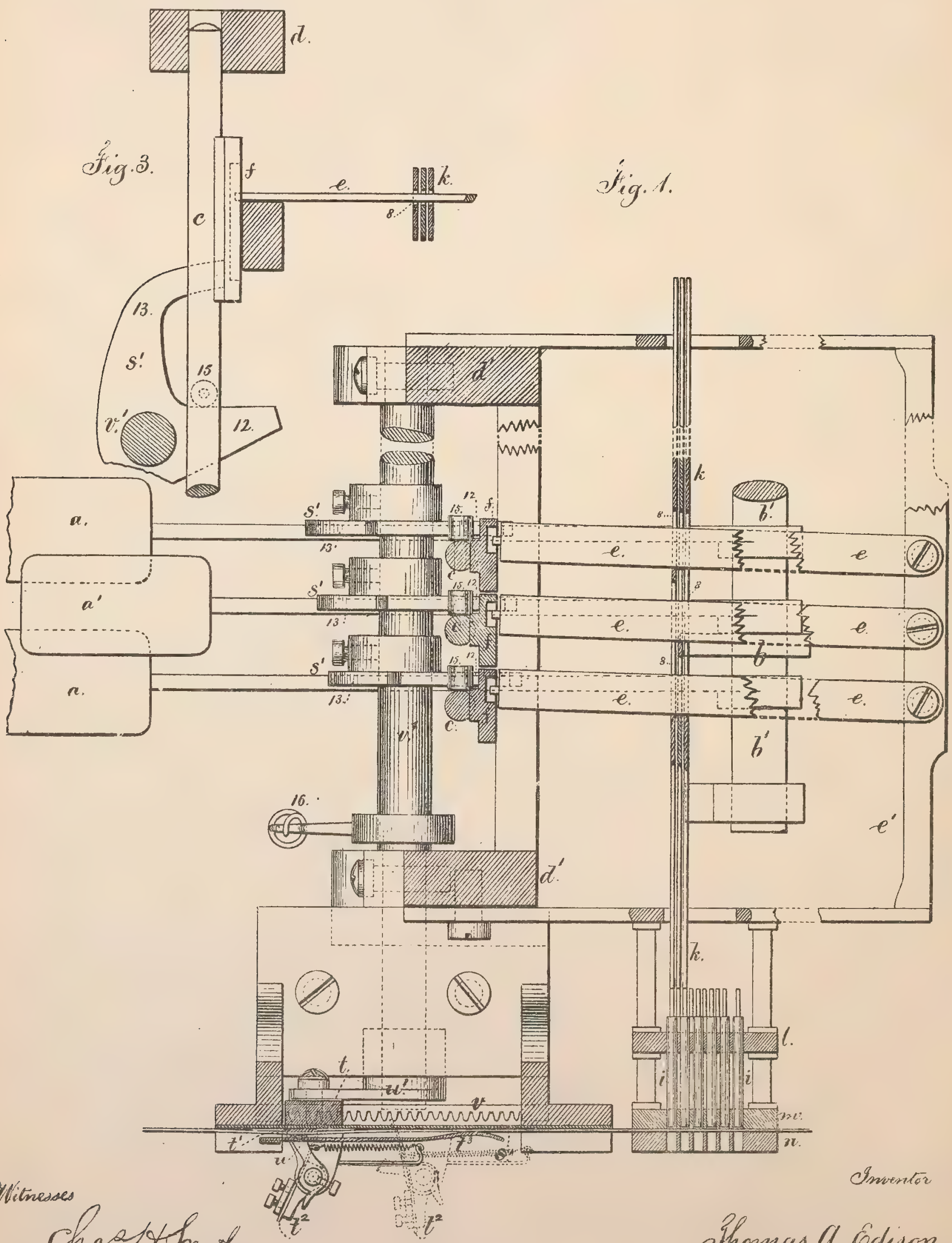
GEO. T. PINCKNEY.

2 Sheets--Sheet 1.

T. A. EDISON.

Perforators for Automatic Telegraphy.

No. 147,312. Patented Feb. 10, 1874.



Witnesses

Chas H Smith

Harold Terrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

att'y

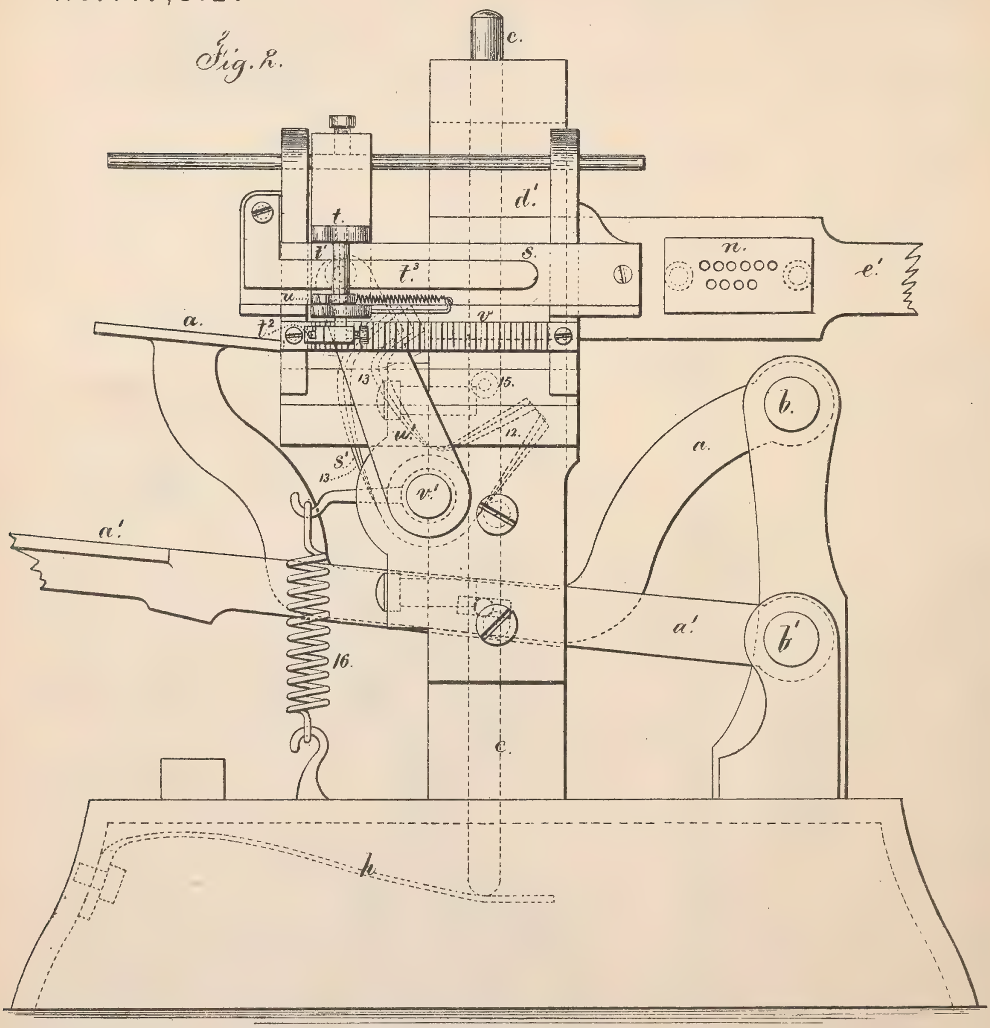
2 Sheets--Sheet 2.

T. A. EDISON.

Perforators for Automatic Telegraphy.

No. 147,312. Patented Feb. 10, 1874.

Fig. 2.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty.

United States Patent Office.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN PERFORATORS FOR AUTOMATIC TELEGRAPHY.

Specification forming part of Letters Patent No. **147,312**, dated February 10, 1874; application filed July 29, 1873.

CASE 75.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Machinery for Perforating Paper for use in Automatic Telegraphing, of which the following is a specification:

This invention is an improvement upon that set forth in Letters Patent No. 121,601, granted to me December 5, 1871, and a reference is hereby expressly made to said patent for a more full and complete description of those parts which are herein only generally referred to.

My present improvement relates to the paper-carrier which feeds the paper, and to the means for giving the feed-motion to said paper-carrier.

In the drawing, Figure 1 is a plan, partially in section, of a portion of my machine. Fig. 2 is an end elevation of the paper-feed and dies; and Fig. 3 is a detached section, showing one of the cams and slide-bars for giving the feed-motion, and also showing the cam for actuating the presser-lever.

The finger-keys a a' are in two ranges, and mounted on the fulcrum-shafts b b', and to these keys the vertical slide-bars c c are jointed. The cams f f are secured to said slide-bars, and they actuate the presser-levers e e and slide-plates k k, which latter operate the punches i, that perforate the strip of paper in the die m n, and these parts thus far described are similar in construction and operation to the corresponding parts set forth in aforesaid patent. The rock-shaft v', which gives motion to the paper-carrier, is mounted in the frame d', and upon this shaft are the cams s', one for each slide-bar c, and each cam is made with the arms 12 and 13, and is upon a hub clamped to said shaft by a set-screw. The roller 15 upon the slide-bar c takes against the arm 12 of s', and gives a partial rotation to the shaft v', when the bar c is moved by a finger-key being depressed, and the amount of motion given to said shaft is determined by the arm 13 of s', which comes against the rear of the cam-plate f on c, as shown in Fig. 3, or against the bar c itself, and acts as a stop to prevent the shaft being turned beyond the point necessary for giving the proper motion to the paper-carrier t.

These cams s' are easily adjusted upon the shaft v', and each cam is positioned so that when a finger-key is depressed, said shaft is only turned the amount required for moving the carrier t, and feeding the paper for the character that is perforated by the depression of that key.

The rock-shaft v' gives motion to the paper-carrier t by the arm w', and this carrier is made with a thin metal plate, t^1, which moves in front of the fence s, and to this plate t^1 the paper is clamped by the pawl u when said paper and carrier are moved forward, and said pawl is turned and lifted from off the paper and plate when the carrier is moved backward.

To operate this pawl u, I employ the spring-arm t^2 and rack v, and this arm is secured to the pivot upon which the pawl u turns. As the carrier t moves backward, the end of the arm enters between two of the teeth of v, and said arm being diagonal to said rack v, the arm yields to accommodate itself to the movement of the carrier, and in so doing acts as a lever and swings the pawl u off of the paper to the position shown by dotted lines in Fig. 1. The pawl u is kept in this position by the end of the arm t^2 riding over the teeth of the rack during the entire backward movement of the carrier. Upon the carrier moving forward, the spring-arm swings the pawl u and brings it in contact with the paper, and clamps it firmly to the plate t^1, and said paper is fed or carried forward by said plate and pawl, the spring riding t^2 over the ends of the teeth and holding the pawl to the paper. The spring t^3 keeps the strip of paper in its proper position against the fence s, and, by its friction, prevents the paper being carried by momentum after the carrier stops.

The operation of this machine, as before mentioned, is similar to that set forth in aforesaid patent, the punches i perforating the paper during the time the carrier is moving back-

ward, and this backward movement is a distance equal to the space for the character that is perforated and the intervening distance. The spring 16 returns the parts to their normal position, and I remark that by this construction the adjustment of the paper-feed is very easily made, and the parts are light and not liable to become injured or disarranged.

I claim as my invention—

1. The stops 13 and cam-arms 12 upon the shaft v', in combination with the finger-keys a a', slides c, rollers 15, and paper-feeding mechanism, substantially as and for the purposes set forth.

2. The spring-arm t^2 upon the pawl u, in combination with the rack v and reciprocating mechanism, substantially as set forth.

Signed by me this 24th day of March, A. D. 1873.

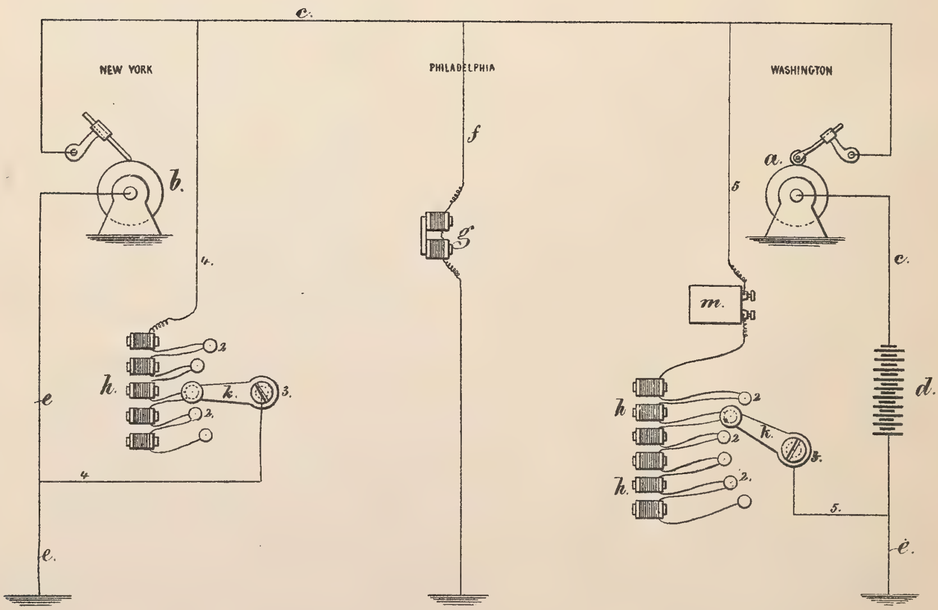
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Chemical Telegraphs.

No. 147,313. Patented Feb. 10, 1874.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **147,313**, dated February 10, 1874; application filed July 29, 1873.

CASE 74.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

In Letters Patent granted to me February 4, 1873, and numbered 135,531, a helix or magnet is employed in a shunt or derived circuit to neutralize the attenuations of the pulsations in the main circuit, and prevent the tailing upon the chemical paper.

The object of the present invention is to adjust the counter or reacting force of the magnets or helices at the receiving station, and also to adjust the reacting force of the magnets or helices at the transmitting station, so as to vary the action of the helices to suit the battery or the conditions of the pulsations at the transmitting and receiving stations.

In the annexed diagram, *a* is the transmitting-instrument, in which the strip of perforated paper is employed to make and break the circuit. *b* is the receiving-instrument for the strip of chemical paper. *c* is the main line; *d*, the main battery; *e e*, the ground-connections. *f* is a branch circuit to the earth, in which the induction-coils or magnets *g* are introduced, as in aforesaid patent. *h* are the induction-coils at the receiving station, and the action of the same corresponds with that set forth in said patent. I, however, employ several electro-magnets or induction-coils, connected together through the contact-pins 2 2, and these are arranged in the arc of a circle, of which the fulcrum 3 of the switch *k* is the center, and to this center 3 one of the shunt-wires 4 connects. By moving this switch *k*, one or more of the helices is placed in the shunt-circuit, and the reactionary effect in clearing the line or instrument of tailing is thereby increased or decreased, as required.

At the transmitting-station the shunt-circuit 5 is provided with the resistance or rheostat *m*, and the electro-magnets or induction-coils *h*, switch *k*, and contact-pins 2 2, so that there may be more or less reactionary effect of the helices *h* to cut off the tailings upon the main line, because, when the circuit is closed at the transmitting-instrument *a*, a large portion of the battery-power passes through the shunt 5, switch *k*, coils *h*, and rheostat, and there is an accumulation of energy in the helices *h*, and as soon as the circuit through the instrument *a* is broken, the magnets *h* discharge themselves with more or less power, according to the number of said helices that are brought into the circuit; and this discharge, being in an opposite direction to the current of the battery, acts to clear the line of any surplus or static electricity, and prevent tailing.

It will be evident that the reactionary effect of the induction-coil or magnets in the shunt-circuit at the transmitting station is to neutralize static electricity, or to bring the line to a normal electric condition instantly, thereby greatly promoting the rapidity of action.

Either the positive or the negative of the transmitting-battery may be to the line, and the other pole to the earth; but the connections of the receiving-instrument must be made accordingly.

I claim as my invention—

1. A shunt or derived circuit at the transmitting station, into which an adjustable resistance and one or more electro-magnets are introduced, as and for the purposes set forth.

2. The combination, with a chemical telegraphic receiving-instrument, of several electro-magnets and a switch, *k*, to connect more or less of said magnets in a shunt-circuit, for the purposes set forth.

Signed by me this 23d day of April, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

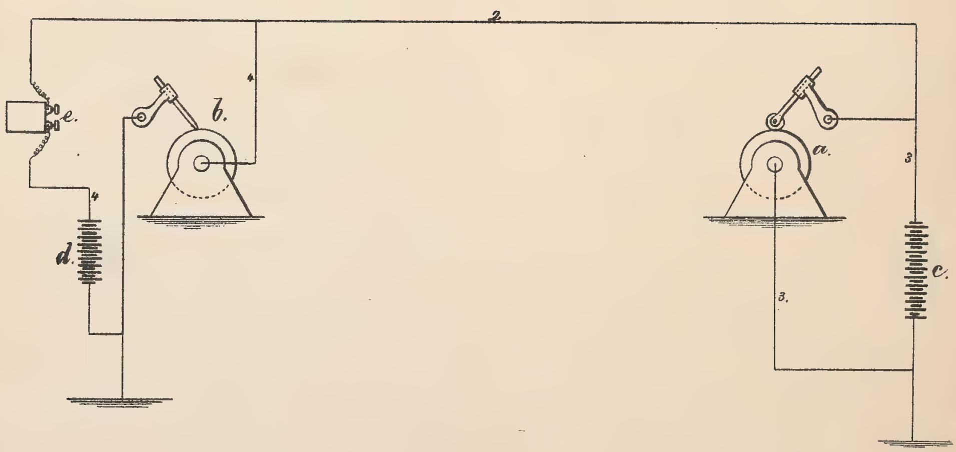
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Circuits for Chemical Telegraphs.

No. 147,314. Patented Feb. 10, 1874.



Witnesses,

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CIRCUITS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **147,314**, dated February 10, 1874; application filed July 29, 1873.

CASE 77.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

This invention is for use in automatic telegraphing in which perforated paper is employed in transmitting, and chemical paper in receiving, the message.

The receiving and transmitting instruments are in shunt-circuits from the main line, and in each circuit there is a battery. These batteries act in opposition to each other, and produce no effect at the receiving-instrument when the shunt-circuit is broken at the transmitter. When this circuit is closed, the current from the battery of the transmitter is short-circuited, and does not pass over the line. This destroys the balance of electrical tension, and the battery at the receiving end of the line acts upon the chemical paper and makes the mark.

In the diagram, the transmitting-instrument is represented at *a*, and the receiving-instrument at *b*, and these are of usual character for transmitting by perforated paper, and receiving by chemical paper. The transmitter is in the circuit 3 to the battery *c*, and the receiver is in a circuit, 4, to the battery *d*, and the main line 2 is connected to these circuits, 3 and 4. The poles of the batteries *c d* are placed so that said batteries oppose each other, and when the strip of perforated paper intervenes between the stylus and drum of the transmitter the circuit 3 is broken, and the current from the battery *c*, over the line 2, and through the receiving-instrument *b* to the earth, is equaled by the current from the battery *d*, and hence no mark is made upon the chemical paper of the receiving-instrument *b*. The rheostat *e* is introduced in the shunt-circuit 4, and should be adjustable, so that the electric energy from the battery *d* may balance that from the line 2, and prevent decomposition in the chemical paper.

When the stylus or roller of the transmitter enters a perforation in the strip of paper, then the short circuit 3 from the battery *c* is closed, and the electricity passes but little upon the line 2. The battery *d* is now unbalanced, and its current, passing by the circuit 4 through the stylus of the receiver, makes the mark upon the chemical paper.

I claim as my invention—

The circuit 4 from the battery *d*, in which the receiving-instrument *b* is placed, in combination with the opposing-line circuit 2 and the shunt-circuit 3 at the receiving-instrument, in which are placed the transmitting-instrument and battery, as and for the purposes set forth.

Signed by me this 24th day of March, A. D. 1873.

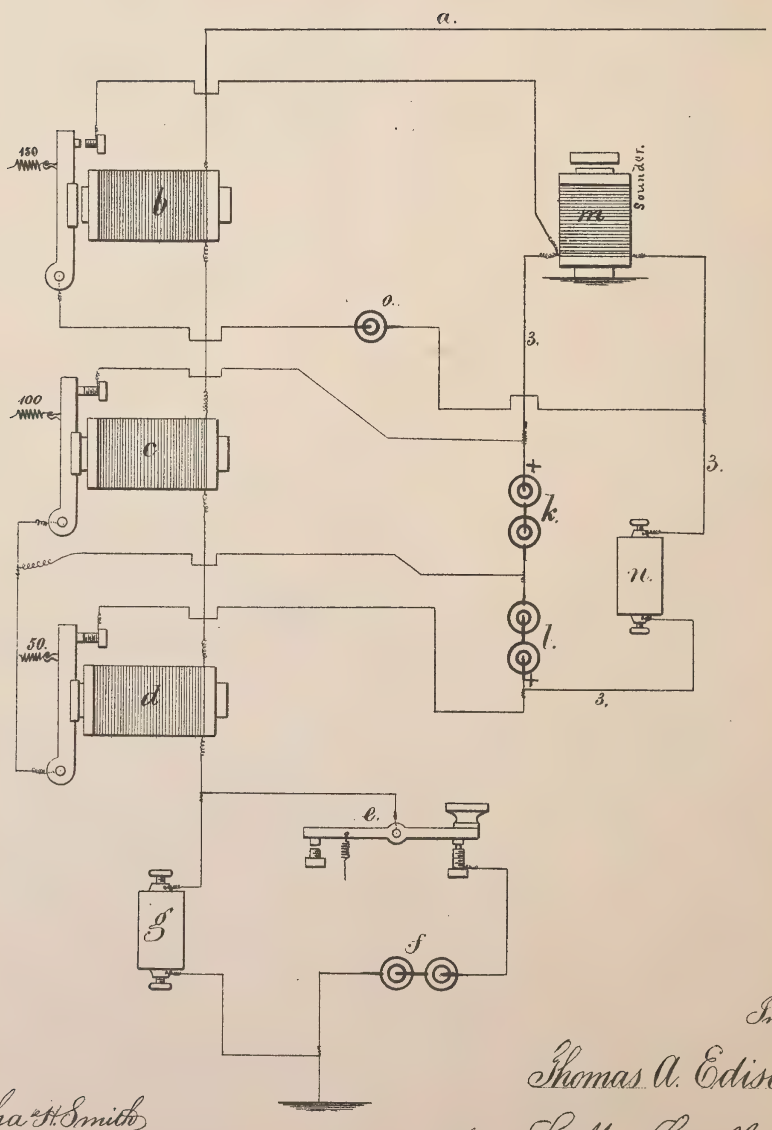
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex-Telegraphs.

No. 147,917. Patented Feb. 24, 1874.



Inventor

Witnesses

Chas H. Smith

Harold Serrell

Thomas A. Edison,

per L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **147,917**, dated February 24, 1874; application filed June 27, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented Improvements in Circuits for Duplex Electric Telegraphs, of which the following is a specification:

This invention is for enabling the operators at both stations to receive simultaneously, and that without the receiving-instrument being affected by the signals transmitted from the same station. I accomplish these objects by arranging the batteries, circuits, and magnets so that the receiving portion of the instrument will only respond to the pulsations from the distant instrument.

In the accompanying diagram, the line *a* is connected, through the electro-magnets *b c d*, to the key *e*, and the battery *f* is divided, half being at each station, as usual. *g* is a rheostat, to prevent the current being short-circuited, but always to maintain a connection of the line to the earth, even when the key *e* may be open. The batteries *k* and *l* are of equal power, and are connected in the circuit 3 in opposition to each other, and in that circuit is the sounder *m*, or other indicating-instrument or call. The battery *k* is connected with the armature circuit-closer operated by the magnet *c*, and the battery *l* with the armature circuit-closer of the magnet *d*. In the circuit 3 is a rheostat, *n*, of sufficient resistance to insure the electricity from the battery *o* passing through the sounder *m* when the circuit-closer of *b* is operated. The instruments at both ends of the line are the same and the adjustments correspond.

The armatures of *b c d* are adjusted to different tensions. Suppose, as an illustration, that the magnet *d* is operated by an electric energy of 50, the magnet *c* by an energy of 100, and the magnet *b* by an energy of 150, and that the power of the battery *f* is 100, but the signal received from one station at the other is only represented by 50. If, now, the operator closes key *e*, both the magnets *d* and *c*, by the power of *f*, respond, and make and break the circuits to the batteries *l* and *k*, and there is no action on the sounder *m* or the magnet *b*. If the operator at the distant station closes his key when the key *e* is closed, the electric tension is increased by the increased energy represented by 50; hence the magnet *b* responds by the joint current from both ends, and operates the sounder *m* by the battery *o*; but if the key *e* is open, the magnet *d* responds to the pulsation from the distant station and short-circuits the battery *l*, allowing the battery *k* to be unbalanced and to operate the sounder *m*. Thus the signal can be received from the distant station whether the key *e* is open or closed, and the operator can also hear the click of his own magnets *c d* without actuating the sounder *m*.

By this arrangement the operators at both ends of the line can be receiving and sending over one wire, and the sounder or receiving-instrument is only operative from the distant station, and it is operative as well when the key *e* is open as when it is closed, and vice versa.

I claim as my invention—

The batteries *k l o* and circuits and circuit-closers of the electro-magnets *b c d*, in combination with the electro-magnetic sounder or call *m* and key *e*, the parts being adjusted to operate substantially in the manner specified.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telegraph Relays.

No. 150,846. Patented May 12, 1874.

Fig. 1.

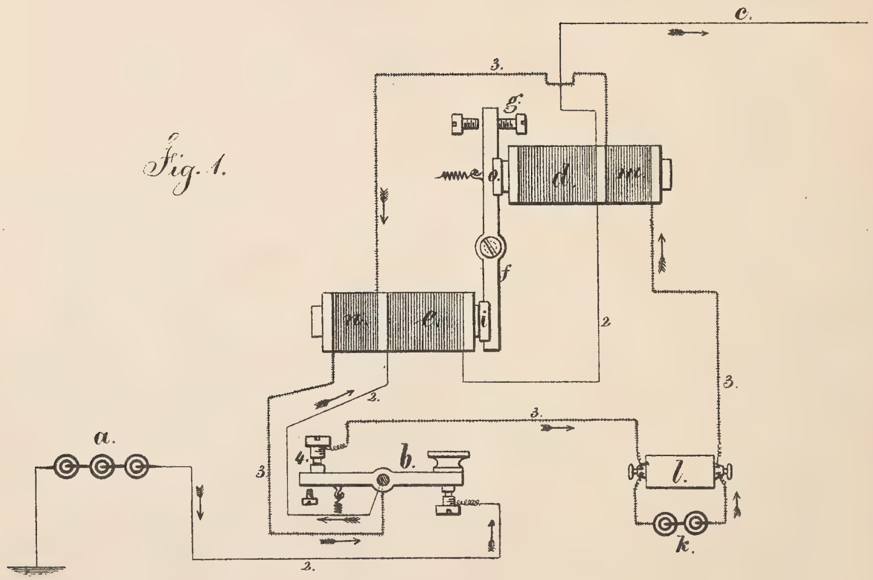


Fig. 3.

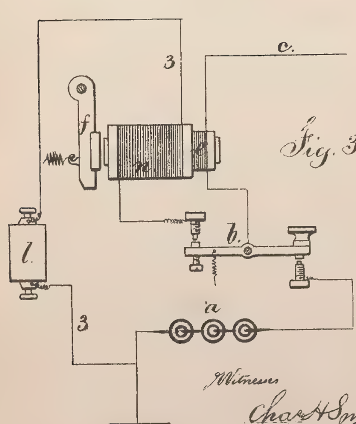
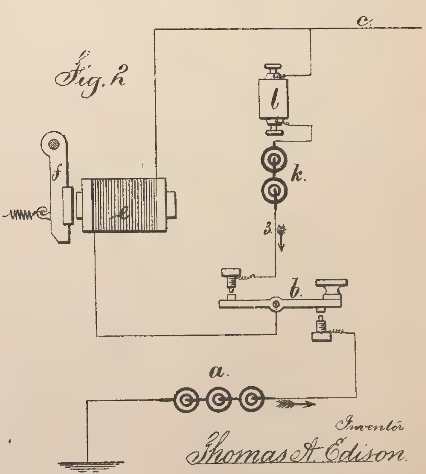


Fig. 2



Witnesses

Chas H Smith

Harold Serrell

Inventor

Thomas A. Edison.

for L. W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPH-RELAYS.

Specification forming part of Letters Patent No. **150,846**, dated May 12, 1874; application filed June 27, 1873.

CASE 81.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraph Instruments and Circuits, of which the following is a specification:

In the most usual way of arranging the circuits for telegraphing, the main-line batteries are nearly equal, and connected in the same line at the two stations, and the circuit composed of these batteries, the line, the instruments, and the earth, is broken or closed at either end to operate the instrument at the other end. In practice, this ordinary mode of arranging the circuits is found very troublesome, because the leaks from the line, especially in wet weather, return to one station, and hence the magnet of the sounder or other receiving-instrument is often powerfully energized when the circuit is broken at the distant station.

My invention is to overcome this difficulty; and consists in connecting, with the electro-magnet, a reverse-acting circuit, that shall neutralize the effect of the escaping current when the instrument is at rest, and thereby maintain the electro-magnet in a condition to respond to the rise of electric tension when the main circuit is closed.

By adjusting the reverse-acting current, the magnet is maintained in the proper condition without resorting to the usual expedients of adjusting the spring, or the relative positions of the core and magnet, and deranging the conditions most favorable for rapid and reliable action in the magnet.

The diagram, Figure 1, in the accompanying drawing, represents the said improvement, and Figs. 2 and 3 show modifications.

The battery *a* and finger-key *b* connect with the line-wire *c*, through the helices *d* and *e*, by the wires 2, and the cores of these helices act upon the armatures *i* and *o* of the lever *f*, and, being at opposite sides of such lever and its fulcrum, the pairs of magnets can be made smaller, and act with greater rapidity upon such lever *f*, either to open and close another circuit at *g*, or perform any other duty. The battery *k* is provided with an adjustable rheostat, *l*, that is in the circuit 3, leading through the secondary helices *m n* of the electro-magnets *d e*, and to the anvil 4. The battery *k* acts in opposition to the current of the battery *a*, and hence tends to neutralize its action in the magnets *d e;* but the rheostat *l* is adjusted so that the current thereof only neutralizes any excess resulting from escape-currents.

The key *b* is to be kept closed when not in use, so that the circuits 2 and 3 will both be closed, and the reverse circuit from *k*, acting in *m n*, will only neutralize any magnetism resulting from the electricity escaping from *a*, through *e* and *d*, due to the defective insulation of the line; but, when the circuit is opened and closed at the distant station, the magnets *d e* will respond with promptness and accuracy by the rise in tension or energy.

By adjusting the rheostat *l*, it becomes unnecessary to adjust the tension of the armature-spring, or the relative position of the armature and core.

When the key *b* is employed in transmitting, the circuit 3 is opened and closed, as well as the circuit 2, to the main line; thereby the armatures will respond, and not be held, as they would by the action of the battery *k* and circuit 3, if that were not broken.

It will be apparent that the electricity of the reverse battery *k* and circuit 3 might be applied to the magnet *e* by a connection between the line and the key, as seen in Fig. 2, and the adjustment be made by the rheostat *l*, as before, or a coil, *n*, may surround the helix *e* of the magnet, wound in reverse directions, so that a portion of the main current passing through a shunt-circuit, 3, and adjusted by a rheostat, *l*, may react to neutralize the escape-current. The diagram, Fig. 3, shows this character of connection.

I claim as my invention—

1. The magnets *d* and *e*, arranged to operate at opposite sides of the armature-lever *f*,

in combination with the battery *k*, circuit 3, rheostat *l*, key *b*, and connections 2 thereto from the main line *c*, and the circuit 3, as set forth.

2. An electro-magnet connected in a circuit with a battery at both stations, combined with a rheostat and counter-current, to neutralize the effect in the magnet of a current arising from leakages in the line, substantially as specified.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Receiving Instruments for Chemical Telegraphs.

No. 150,847. Patented May 12, 1874.

Fig. 2.

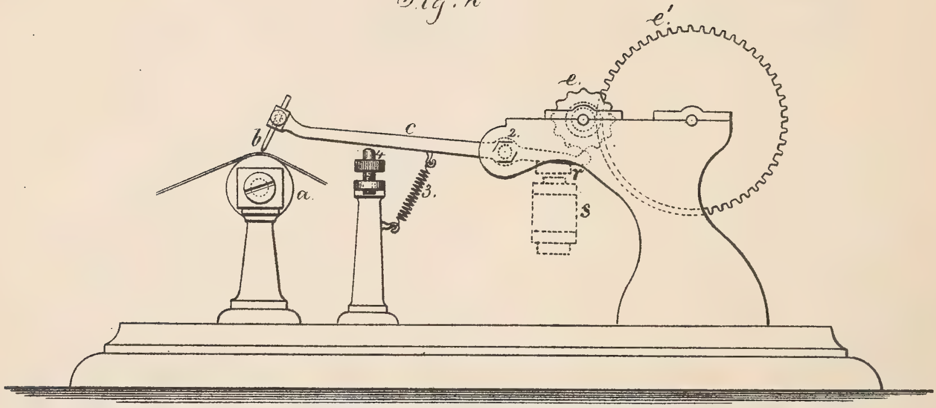
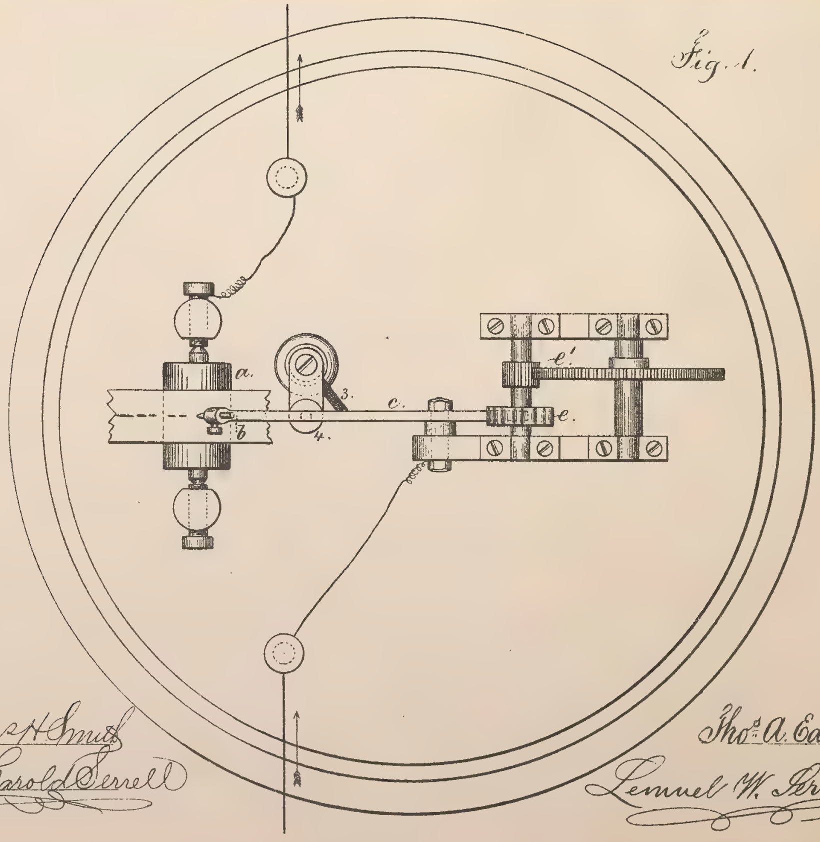


Fig. 1.



Witnesses

Chas H Smith

Harold Serrell

Inventor

Thos A. Edison

Lemuel W. Serrell

atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN RECEIVING-INSTRUMENTS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **150,847**, dated May 12, 1874; application filed July 29, 1873.

CASE 72.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Receiving-Instruments for Automatic Telegraphing, of which the following is a specification:

In automatic telegraphing, where perforated paper is employed for transmitting, and the message is received upon chemical paper, the marks made upon said chemical paper are often more or less blurred or tailed together when the speed of transmission is very rapid; and this is caused by the static charge or surplus electricity on the line acting upon the paper after the circuit is broken by the transmitter.

My present invention is made to lessen this blurring or tailing of the marks upon the chemical paper; and I accomplish this result by employing a stylus which is vibrated with great rapidity to make and break contact with the paper as the same is drawn along beneath such stylus.

This vibrating stylus offers no impediment to the electric wave or pulsation when the circuit is closed by the tranmitter; hence the mark is made upon the paper; but when the circuit is broken the surplus electricity on the line is not sufficiently powerful to produce any tailing to the mark, because the vibrating stylus is not long enough in contact with the paper for this weak portion of the current to decompose the chemical substances in the paper.

In the drawing, Figure 1 is a plan, and Fig. 2 is a side view, of a device which may be used for vibrating the stylus.

a represents the drum or roller of a receiving-instrument, and over this drum the strip of chemical paper is drawn, as usual. The stylus *b* is upon a lever, *c*, and this lever moves upon the fulcrum 2, and is vibrated very rapidly by the notched or toothed wheel *e* acting upon a projection or tooth upon said lever. The spring 3 aids in giving the downward movement to the lever and stylus, and insures the stylus touching the paper. An adjustable stop, 4, limits this downward movement of the lever and stylus. The wheel *e* may receive its rapid movement from gearing *e′*, operated by a weight, spring, or electro-motor, or the lever may be provided with an armature, *r*, and vibrated by an electro-magnet, *s*, (shown by dotted lines,) the circuit to which is opened and closed by the movement of the lever *c*.

When the circuit is closed at the transmitter by the stylus or roller entering a perforation in the paper, the electric pulsation or wave passes over the line to the stylus *b* and makes a mark upon the chemical paper, and the vibration of said stylus causes no material difference in the appearance of the mark made, because the current is strong so long as the circuit is closed, and it acts through said stylus the same as though it were resting on the paper all the time. When the circuit is broken at the transmitter, the surplus current which remains on the line prevents this portion of the current passing to the chemical paper; hence the tailing is not made to the mark.

I claim—

A stylus for a chemical receiving-instrument, in combination with mechanism for communicating to such stylus a rapid vibration toward and from the paper, for the purposes set forth.

Signed by me this 24th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS H. SMITH.

T. A. EDISON.

Chemical or Automatic Telegraphs.

No. 150,848. Patented May 12, 1874.

Fig. 1.

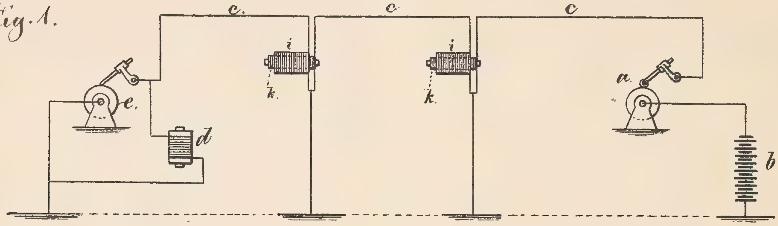
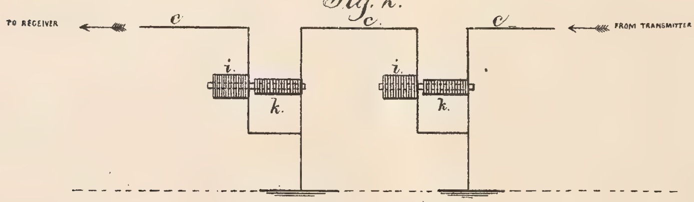
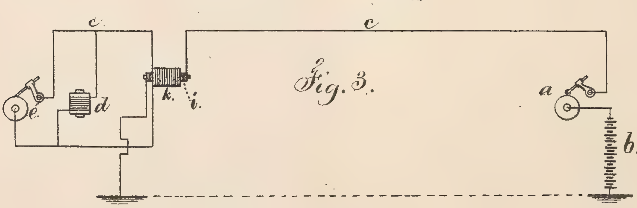


Fig. 2.





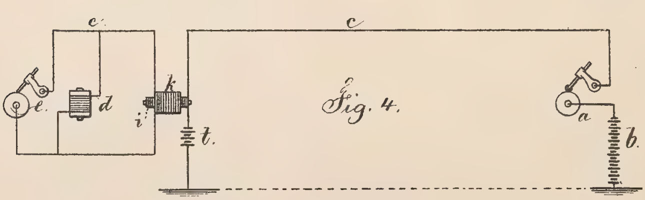
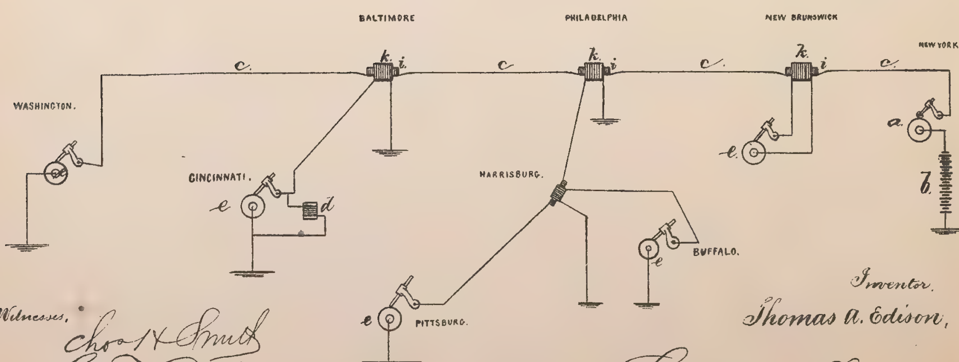


Fig. 5.



Witnesses,
Chas H Smith
Geo. T. Pinckney

Inventor.
Thomas A. Edison,
Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL OR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **150,848**, dated May 12, 1874; application filed January 15, 1873.

CASE 64.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Circuits, of which the following is a specification:

It is well known that in the induction-coil of an electro-magnet or primary helix a secondary current is induced or set up, and that this can be conveyed over a wire, and will pulsate with the primary current through the magnet-helix.

In chemical telegraphs great rapidity can be obtained upon short lines, while upon long lines the speed is rapidly diminished by increasing the distance. The current required in chemical telegraphs and cables is comparatively weak. I therefore make use of the secondary current from an induction-coil of an electro-magnet or primary coil as a relay for continuing the transmission of the message in long lines, and that without lessening materially the rapidity, and without blurring the message, as received, by tailings resulting from surplus or static electricity in the line, as now usual in long lines.

By the means before mentioned, all mechanical devices and movements, such as armatures, levers, and relay circuit-closers, are dispensed with, and the electrical operation alone relied upon, and I am able to operate chemical-telegraph lines with a rapidity heretofore unsurpassed. I divide the line up into sections of suitable lengths—say, about four or five hundred miles each—employing a line from the transmitting-station as long as can be used to advantage, and then introducing an induction-relay, either reaching to the receiving-station or to the next induction-relay. In some instances I make use of the induction-relay in operating local or branch circuits.

In the drawing, a is the transmitting-instrument; b, the battery; c, the line-wire of the main circuit. k is the induction-relay, and e is the receiving-instrument.

The induction-relay is preferably of large wire with a large number of convolutions, so as to obtain an increased quantity in the induction-current. One coil may be outside the other coil, as shown in Figure 1, or the induction-coil i may be separate upon the same core, as the primary helix k, as seen in Fig. 2. The primary or main circuit passes through the helix k; thence to the earth. The secondary or induction circuit is connected from the coil i to line-wire and distant instrument, and also to the earth.

In Fig. 1 the entire line is represented as divided into three sections, the first one being operated by the primary current, and the second section by the induced current, which, in turn, operating in the second induction-relay, operates in the third circuit that extends to the receiving-instrument. The number of circuits operated by induced magnetism may be increased, and I remark that, in consequence of the instantaneous action of the induced current, the transmitting-machine has to be worked with great rapidity, and that the dot-alphabet is preferable to the dot-and-dash alphabet.

In Fig. 3 a single primary circuit is shown, with an induction-circuit to operate the receiving-instrument. A rheostat or adjustable rheostat may be employed to regulate the proportion of current passing to the chemical paper.

In Fig. 4 a battery, t, is applied to the line near the induction-relay, of less power than the transmitting-battery, and with the opposite pole to the line, so as to clear said line, with rapidity, of static electricity or attenuation in the pulsations. In this case the induced or secondary current is produced by the increase and decrease of the current.

In Fig. 5 the transmitting-instrument is illustrated as being at New York, and working to Washington, and at Philadelphia and Baltimore primary and secondary coils, so that the induced circuits set up at these places can work to Cincinnati and Pittsburg; and at Harrisburg an induction-coil that sets up a second induction-circuit to Buffalo.

At any of the receiving-stations there may

be an electro-magnet in a local circuit to set up a counter-circuit when the pulsation ceases, to prevent tailing, as shown at *d*.

If required, there may be branch circuits, resistances, and connections to the earth from either the primary or the secondary circuits, to aid in clearing the line of surplus electricity.

In rapid automatic telegraphy the secondary current, although but momentary, is of greater intensity when the primary current is prolonged, (as with a dash,) so that the difference between dots and dashes is apparent in the chemical paper; and in cases where the difference is not sufficiently apparent the dot-alphabet will be used.

I do not claim the secondary circuit acting in a magnet to produce a signal.

I claim as my invention—

A circuit for chemical telegraphs, composed of the primary circuit operated by the transmitting-instrument, and an induction-relay coil to act in the receiving-instrument by a secondary circuit, substantially as set forth.

Signed by me this 12th day of December, 1872.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

2 Sheets--Sheet 1.

T. A. EDISON.

Automatic Telegraphy and Perforators Therefor.

No. 151,209. Patented May 26, 1874.

Fig. 1.

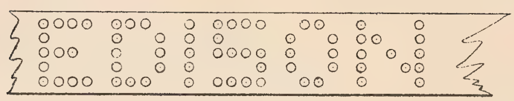


Fig. 2.

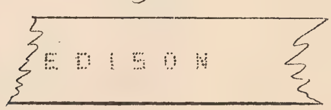
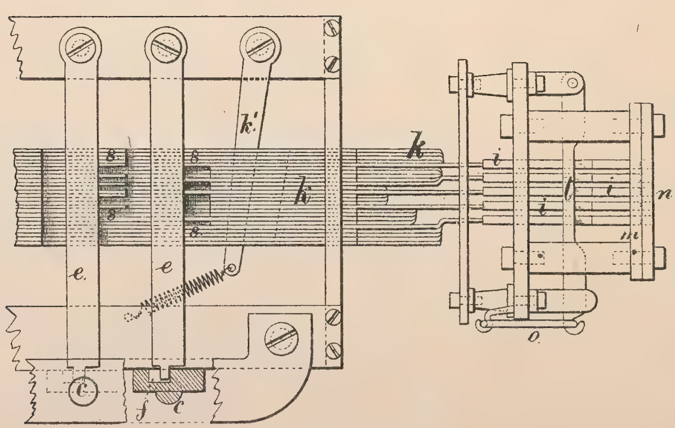


Fig. 3.



Inventor

Witnesses,

Chas H. Smith

Geo. T. Pinckney

Thomas A. Edison

per Lemuel W. Serrell

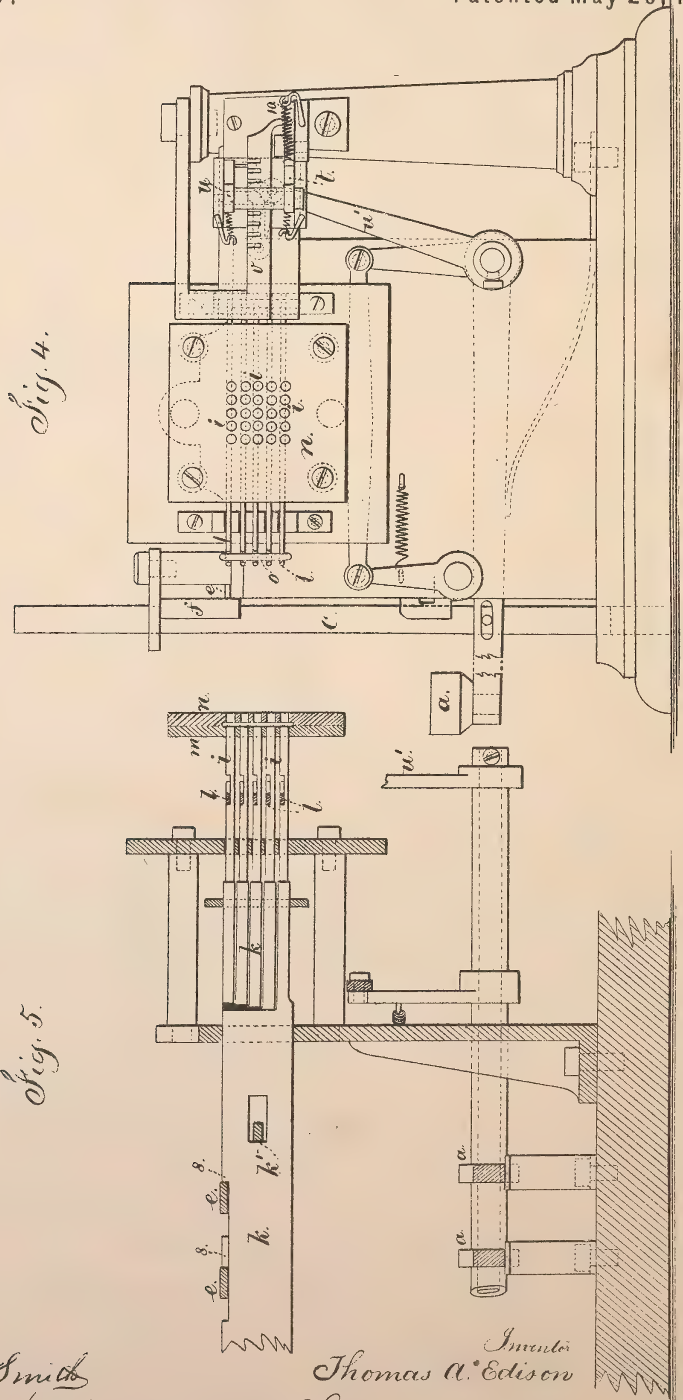
atty.

2 Sheets--Sheet 2.

T. A. EDISON.

Automatic Telegraphy and Perforators Therefor.

No. 151,209. Patented May 26, 1874.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC TELEGRAPHY AND IN PERFORATORS THEREFOR.

Specification forming part of Letters Patent No. **151,209**, dated May 26, 1874; application filed September 2, 1873.

CASE 83.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphing; and the following is declared to be a correct description of the same.

In the Morse system of telegraphy the operator frequently receives the message by sound, and writes the same out as received. In the printing-telegraph system, the printed strip itself is usually delivered as received. In the ordinary automatic system, the paper has to be punched or composed; and, at the receiving-station, the message on the chemical paper has to be translated and written out by hand, or printed by a key printing-instrument. Each system has its defects or disadvantages. The Morse system is slow, and requires a large number of wires. The printing-telegraphs are expensive, liable to inaccuracies and injury, and limited in speed to the fingering of the keys. The automatic system is rapid on the line, but the composing of the message and the writing of it out at the receiving-station are comparatively slow operations.

The object I have in view is to print the message chemically. Thereby the message, as received upon a strip of paper, is ready to be folded and sent to its destination; and the rapidity is equal to any automatic transmission. I accomplish this object by perforating the strip of paper used for transmitting with groups of holes, representing by each group a letter or character, the perforations being arranged to produce, as nearly as possible, the block or Roman letters or characters.

The transmission of the message by the line-wires may be in the usual manner, by a roller or stylus, and a line-wire to each row of perforations, so that, if there are five rows of perforations, there will be five stylus-points or rollers, each connected to a line-wire, and, at the receiving-instrument, there will be five pens or stylus-points near together, and the letter received will be in dots corresponding to the position of the perforations in the transmitting-paper, and, by their aggregation in groups, the letters will be clearly delineated, and formed almost as perfectly as printed characters, so that the strip of chemical paper can be delivered, and the rewriting or printing of the message dispensed with. The message, as received, being the counterpart of that transmitted, the perforated paper at the transmitting-station becomes a perfect record of the message, and the line can be worked up to its utmost capacity, because the paper can be perforated for transmitting about as rapidly as an ordinary printing-telegraph can be operated, and as many perforating operators and machines can be used as are necessary for the work that is to be done on the lines.

I have herein indicated the mode of using this improvement with five line-wires; but I contemplate to use the transmitting-paper, perforated as herein described, with transmitting and receiving mechanism that will operate with only one line-wire, and are to form the subject of a separate application.

In the drawing, Figure 1 represents a piece of paper with perforations, and adapted to use in transmitting. Fig. 2 shows the chemical paper with the same word printed thereupon by the dots running together, or being sufficiently close to each other to show the respective letters. Fig. 3 is a plan of a portion of the perforating-machine. Fig. 4 is an elevation endwise of the punches, and Fig. 5 is a partial section longitudinally.

I find that five lines of perforations are the most convenient for producing perforations in imitation of block letters or characters, and have shown and described such; but I am not limited in that respect.

Reference is hereby made to Letters Patent No. 121,601, granted to me December 5, 1871, for a machine for perforating paper for telegraphic purposes, which, with the modifications herein set forth, is adapted to punching the characters in the strip of transmitting-paper.

Instead of having two lines of punches, *i i*, as in aforesaid patent, these punches *i i* are twenty-five in number, positioned in a square of five each way, and as close together as convenient. Each punch is connected with its slide-plate *k*, and these slide-plates *k* are side

by side, and supported in the frame of the machine, so that they can be moved endwise with facility, and actuate the punches to which they are connected, respectively. The punches slide in the plate *m;* and *n* is the die-plate, as in said patent. There might be a spring to each slide-plate *k* and punch *i;* but I have shown a lever, *k'*, passing through mortises in the plates *k*, and provided with a spring to draw all the punches and slide-plates back to their normal position after they have been actuated.

If the punches are separate from the slide-plates, each row may be provided with a lever, *l*, and spring *o*, to return or draw back the punches; and said levers *l* act within notches in the punches, as shown.

The shoulders or projections 8 are provided upon the slide-plates *k*, contiguous to the respective pressers *e*, and these projections 8 are only upon such of the slide-plates that require to be moved by the presser to which they are adjacent, to operate the punches required to perforate the letter corresponding to the one on the finger-key *a* that is connected to the particular presser *e*, as in aforesaid patent; and I remark that the slide-bars *c* and connecting-cams *f*, or forks to move the pressers *e* by the finger-keys *a*, may be similar to those shown in said patent, and the lever *w'*, feeding - clamp *t*, pawl *u*, rack - bar *v*, and pawl 10 are similar to the parts shown, and they operate in the manner described in the aforesaid patent, and therefore do not require further description.

From the illustration given in Fig. 1, the general character of the groups of perforations will be apparent, and, in the square of twenty-five punches, the proper ones can easily be selected to perforate any given letter or character, sufficiently like block letters to be reliably read, at the receiving-station, on the chemical paper.

I am aware that types have been used in telegraphing characters, and also that letters have been made by punching slots and circular holes; but this mode of perforating could not be accomplished by one group of punches to perforate any letter by selecting punches from that group. Furthermore, the slots under the paper are liable to tear.

I claim as my invention—

1. A strip of telegraphic transmitting-paper perforated with holes of uniform size, grouped together to represent ordinary letters or figures, substantially as set forth.

2. The mechanism for making groups of perforations in a strip of paper in imitation of letters or characters, the same consisting of punches massed together in a square, or nearly so, and mechanism intervening between such punches and the finger-keys, for selecting from such mass of punches those that are required for perforating characters corresponding with the characters upon the respective finger-keys, substantially as set forth.

Signed by me this 25th day of August, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

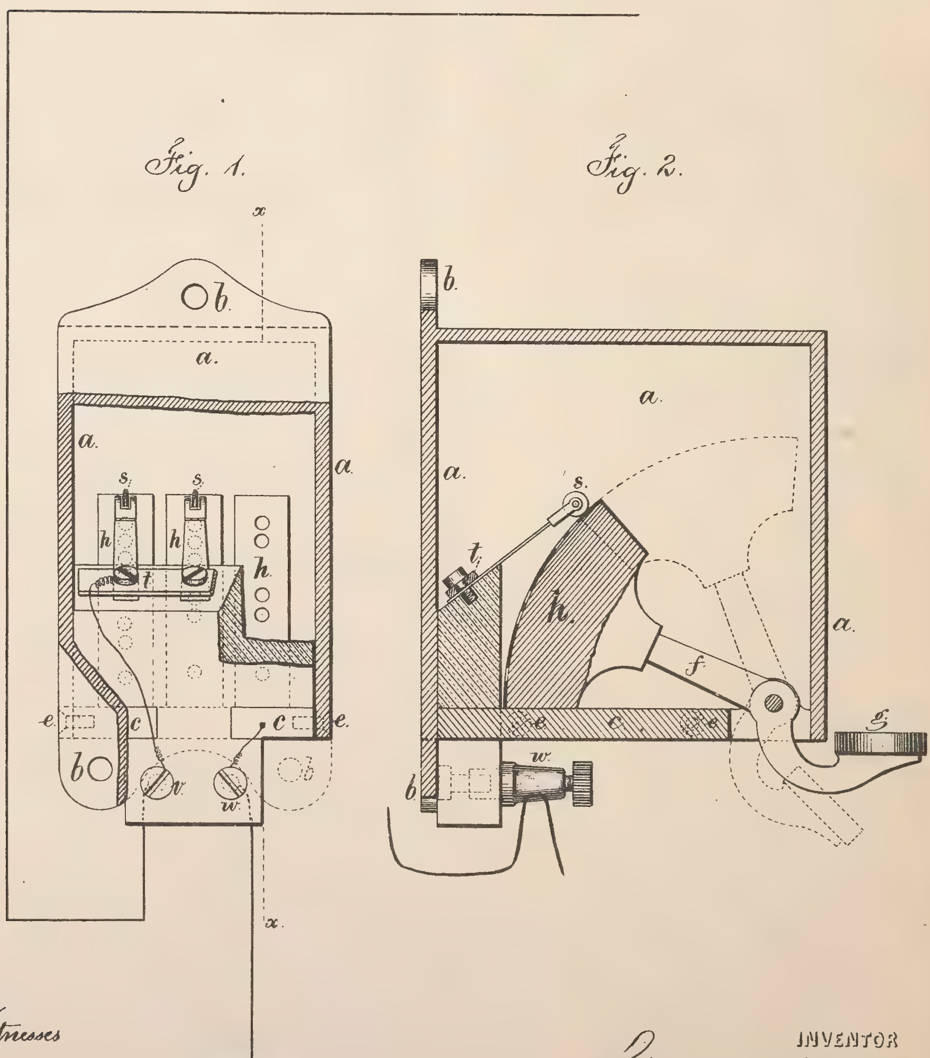
CHAS. H. SMITH.

T. A. EDISON.

District Telegraph Signal-Boxes.

No. 154,788. Patented Sept. 8, 1874.

Fig. 1. Fig. 2.



Witnesses

Chas H. Smith

Geo. D. Walker.

INVENTOR

Thomas A. Edison.

per Lemuel W. Serrell

atty.

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DISTRICT TELEGRAPH SIGNAL-BOXES.

Specification forming part of Letters Patent No. **154,788**, dated September 8, 1874; application filed May 11, 1874.

CASE 86.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, havented an Improvement in District Telegraphic Alarm and Signal Apparatus, of which the following is a specification:

Devices have heretofore been made in which a lever is depressed to send a telegraphic signal to a central office, and indicate a number that is allotted to the building sending the signal, and understood as a call for a "messenger," or another number by another lever for a call for "police" or for "fire." These devices are generally provided with electro-magnets, and are costly in construction and slow in operation, and contain a means for indicating whether the line is free. My improvement is made to simplify the construction of the signaling apparatus and render it very rapid in operation, so that a number of instruments can be safely connected in one circuit without risk of interfering with each other. The signals are received upon chemical paper.

I make use of an instrument which I term a "domestic telegraph;" it is in a branch circuit from the main line, and it contains two or more levers with circuit-closing segments, with alternate conducting and non-conducting material, so as to make and break the circuit in the branch and thereby give a signal at the central office, either by numbers or letters, the meaning of which is pre-arranged, so as to know the location from which the signal is sent and the meaning of that signal.

In the drawing, Figure 1 is a rear view of the instrument, with the case broken open to represent the interior parts; and Fig. 2 is a section at the line *x x*.

The case *a*, containing the operative parts, is, by preference, made of metal, and adapted to being screwed at *b* against a wall. The operative portions of the machine are upon the removable bottom *c*, hence they will be protected from injury or dust by the case, and can be taken out by removing the pins or screws that pass into the edges of the bottom, as seen at *e e*. Each lever *f* is made with a finger-piece, *g*, projecting outside the case, and a segment-head, *h*, that acts both as a weight to return the lever to place and a circuit-closer. The convex surface of the lever-segment is made with alternating conducting and non-conducting surfaces, to give the required pulsations. A convenient device for this purpose is a strip of paper, perforated at the required places, and attached to the surface of the metal. The contact-rollers *s* are at the ends of spring-arms and bear upon the circuit-segments *h*, and these spring-arms are connected together by the plate *t*, that is in metallic connection to the insulated binding-screw *v*, and the wire from this leads to the line, and the binding-screw *w* is in metallic connection with the plate *c* and levers *f*, and its wire leads to ground. The rollers *s s*, resting on insulating material in a normal position, the branch to the earth from the main line will remain broken, but as one of the levers is depressed and the segment thrown up into the position shown by dotted lines in Fig. 2, the circuit through the branch will be closed and pulsations sent, of the length and relative distance apart, according to the character of the conducting surface on the segment. These pulsations will be repeated in reverse as the lever falls, thus insuring accuracy by the repetition of the signal, and the entire signaling occupying such a small time—not more than two or three seconds—the risk of a simultaneous signal from some other instrument is so small as to require no attention.

I claim as my invention—

1. A signal apparatus, composed of a lever with a segmental circuit-closing surface, a contact-roller, a finger-key and connections, substantially as set forth.

2. A circuit-closing segment and a weight at the end of a lever, in combination with a circuit-closer and connections, substantially as set forth.

3. A telegraphic alarm and signaling apparatus, formed of two or more levers with circuit-closing surfaces contained within a box, with finger-pieces outside said box, substantially as specified.

Signed by me this 2d day of April, A. D. 1874.

THOMAS A. EDISON.

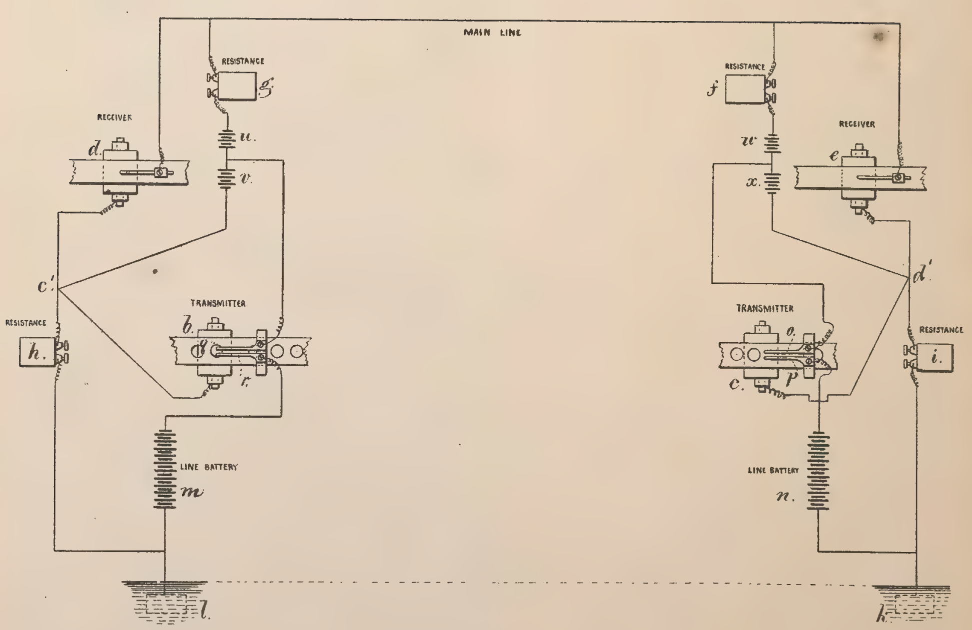
Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

Case 69.

T. A. EDISON.

Duplex Chemical Telegraphs.

No. 156,843. Patented Nov. 17, 1874.



Witnesses,
Chas H Smith
Geo: D. Walker.

Inventor
Thomas A. Edison
L. W. Serrell
atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN DUPLEX CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **156,843**, dated November 17, 1874; application filed March 13, 1873.

CASE 69.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Circuits for Chemical Telegraphs, of which the following is a specification:

The object of this invention is to transmit two dispatches over the same wire at the same time by telegraphs employing perforated transmitting-paper and chemical receiving-paper.

I make use of apparatus for transmitting by perforated paper, and receiving the messages on chemical paper at the respective ends of the line, and employ batteries, resistances, and connections arranged in such a manner that the effect of the transmitting-battery shall be neutralized upon the receiving-instrument at the same end by an equalization of tensions, and the receiver shall be at a point where the tension is equal to all the electric currents, except to that current which comes from the distant station.

In the diagram, *d e* are the receiving, and *b c* the transmitting, instruments. *m n* are the main batteries. *u* and *v* are two batteries in the shunt-circuit opposing each other, and producing no effect upon the receiver. *w x* are batteries operating similar to *u v*. *f g* are resistance-coils, to increase and decrease the length of the shunt-circuits. *h i* are resistance-coils of nearly the resistance of the line. *k l* are the ground-plates. *o p* are the double contact-springs, one spring, *o*, cutting off or "short-circuiting" the battery *x*, and the other spring, *p*, placing the main battery *n* upon the line. This main-battery current divides at *d′*, part going on the line and part to the ground, this route or negative of the battery through the resistance *i* being in fact an artificial line, it being well known that a battery will supply several lines with an undiminished quantity of electricity, and that the addition of a line decreases the total resistance of the battery's circuit, and produces an extra amount of electricity.

To obtain the transmission of two messages over the same wire at the same instant, it is only necessary that no effect shall be obtained upon the receiving-instrument by the putting on of the sending-battery at the same station.

I will now describe how I produce this effect: When the paper of the message to be transmitted intervenes between the contact-springs *q r* and the drum *b*, no current passes upon the line, and the batteries *u v*, being balanced within the shunt-circuit, produce no effect upon the receiver *d*, and a current coming from a distant station passes down the shunt, and also through the receiver *d*, and produces the message in the usual manner.

Supposing no current from the distant station was recording itself upon the receiver *d*, and it is desired to transmit a current to the distant station without producing any effect upon said receiver *d*, it is accomplished as follows:

When the contact-springs *q r* are in metallic contact with the drum *b*, by passing into a perforation in the paper being drawn over said drum, the current from the battery *m* passes by *r* over the line, but it splits in three directions at *c′*, part passing to the ground, and part passing by two routes to the line, via the shunt and the receiver *d*. The passage of the current through the receiver would give a large mark at the receiver were it not that at the same time that the contact-spring *r* placed the battery *m* upon the line the spring *q* short-circuited the battery *v*, which had been opposing the battery *u* in the shunt, hence allowing said battery *u* to have free action, and the current from this battery thus set free acts in a contrary direction through the receiving-instrument *d* to that of the battery *m*, and by means of a switch for putting in and out more or less cups the power of the batteries *m* and *u* is neutralized on the chemical paper at *d*; consequently no effect is produced at the receiver *d* when the battery *m* is placed on the line.

Of course, while the battery *m* is on, if a current from the battery *n* is sent over the line it records itself in the usual manner upon the chemical paper on *d*.

I claim as my invention—

The local batteries u and v or w and x in a shunt from the main line and opposing each other, and a connection between them to the transmitting or receiving instrument, in combination with the main batteries, resistances, and circuits, arranged substantially as and for the purposes set forth.

Signed by me this 7th day of March, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telegraph Apparatus.

No. 158,787. Patented Jan. 19, 1875.

Fig. 2.

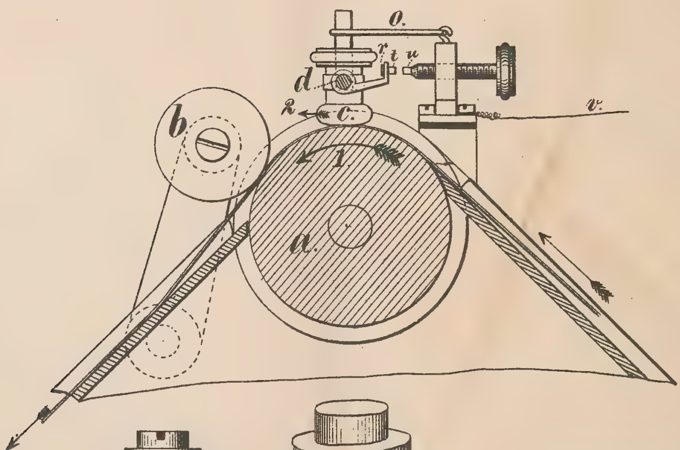
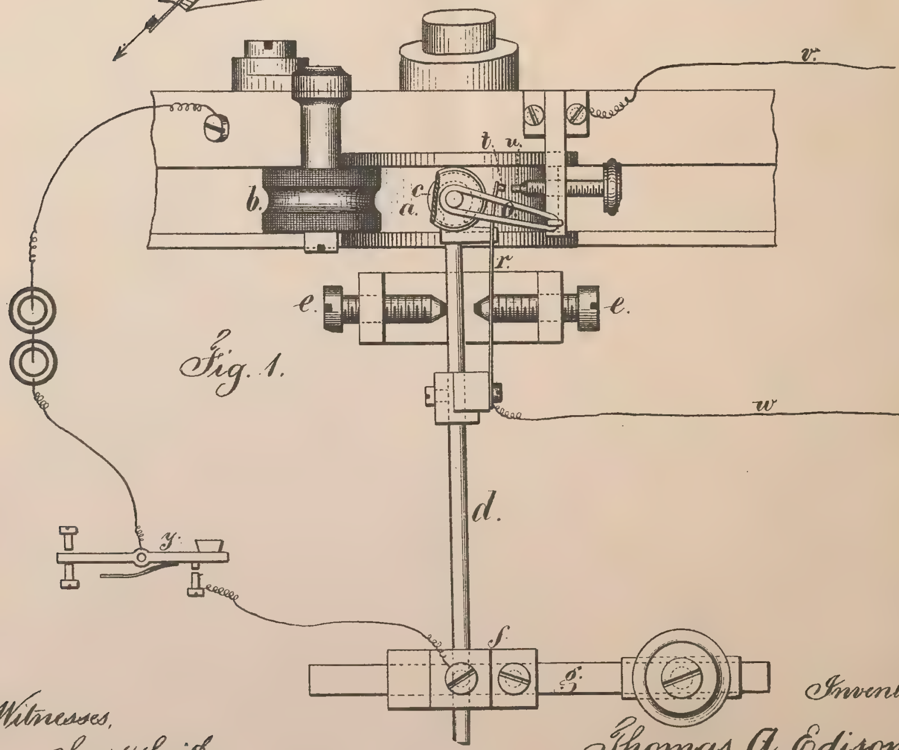


Fig. 1.



Witnesses,
Chas H Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **158,787**, dated January 19, 1875; application filed August 13, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

In electric telegraphs motion has been obtained at a distance by a galvanometer and by an electro-magnet. Both of these are comparatively slow, and hence chemical decomposition has been resorted to for recording the characters sent from a distant station.

Heretofore there has been great difficulty in obtaining any means for repeating messages with high rates of speed, and magnets or galvanometers in an electric circuit always produce more or less disturbance by the secondary or induced current, and act to reduce the speed.

My invention is dependent on mechanical motion and electrical action, and responds to the most feeble currents when properly adjusted, and with very great rapidity; hence I term my invention the electric motograph.

The principles of its operation are that, when a moving surface is in contact with a slightly-yielding substance, the tendency is to move the latter by and with the former. If the circumstances of contact are varied the adhesion of the surfaces will be sufficient to cause the moving surface to move the yielding substance, or else to cause the yielding substance to slip more freely, and by its spring go in the opposite direction to the moving surface. I have discovered that the passage of electricity through the surfaces in contact will change the frictional adhesion, making it more or less according to the substances employed; and by balancing the mechanical forces so that when the surfaces in contact are not electrified the moving surface carries with it the yielding surface, and when electrified the yielding surface slips back over the moving surface, or vice versa, a mechanical movement is produced that is dependent on the electrical condition of the surfaces in contact; hence mechanical motion is obtained, first one way and then the other, that is as unlimited in its speed as the pulsations of electricity that pass, unobstructed by magnets or other hinderances, over the telegraphic lines.

In the drawing, Figure 1 is a plan of the apparatus, and Fig. 2 is a vertical section.

The drum *a* is revolved by clock-work or other suitable means; and *b* is a roller to press a strip of paper into contact with the drum *a*, so that said strip is drawn along with regularity; and *c* is the frictional presser and yielding vibrator. This vibrator is at the end of an arm, *d*, that allows it to yield, and the extent of motion should be limited by the adjusting-screws *e*. I prefer to make this arm serve the purpose of a spring, although separate springs might be used to regulate the pressure of the vibrator on the moving surface, and the force applied to draw the vibrator in the opposite direction to the movement given by the moving surface *a*, as illustrated by the rubber spring at *o*. The spring-arm *d* is upon the block *f*, that may be slid endwise upon the rod *g*, to regulate the power of the spring in moving the vibrator, and pressed down more or less to determine the friction between the vibrator and the moving surface.

If the surface of *a* is moving in the direction of the arrow 1 and the parts are properly adjusted, the friction will be sufficient to move the vibrator slightly in the direction of the arrow 2; but when the electric current passes through the surfaces of *a* and *i* the frictional contact will become less, so that the spring will overcome the friction and vibrate *c* in the other direction as the current is broken. The friction increasing, the vibrator moves the other way. If the surfaces in contact are of such a character that the frictional contact will be intensified by the electrical action, then the movements will be the reverse.

It will now be evident that the movement of the vibrator can be availed of for any electrical or telegraphic purpose.

By applying the spring *r* and circuit-closing points *l* and *u*, and insulating these parts, the local or relay circuit of which the wires *v* and *w* form parts will be opened and closed simultaneously, and in harmony with the key *y* or other transmitter in the circuit that passes through the vibrator *c* and drum *a*.

I do not limit myself to the use of any particular chemical substances, for water will, under some circumstances, answer for moistening the strip of paper or moving surface, or

the moving surface may be of lead or other metal, and the surface of the vibrator be made of paper or other material, and moistened by preference.

In my experiments I have discovered that paper moistened with bromo chloralum and a lead vibrator connected to the positive pole increases the friction. I presume that the electric decomposition produces an effect similar to that resulting from the addition or removal of a lubricant, because, when the positive pole is connected with the vibrator the apparatus is not operative; hence the result named cannot proceed simply from the surfaces being electrified. Furthermore, the effect of relieving friction is most apparent at the commencement of the electric action; hence there may be a decomposition of the metallic oxide formed on the surface by the hydrogen evolved at the negative pole. With hydrate of potassa the resistance of the moistened paper to the passage of the current is but little, and excellent results are obtained.

My tests on different metals have shown that most all of the metals will operate to a greater or less extent with various solutions; but thallium and lead appear to be preferable, especially the latter, as acting with great delicacy where hydrogen is evolved by the decomposition; but I do not limit myself to any particular character of moving surface and vibrator so long as the characters of such surfaces are such that the frictional contact will be so changed when electrified as to cause or allow of the movement of the vibrator.

Paper moistened with alcohol, even absolute alcohol, will operate with a lead vibrator. With sulphate of quinine and hydrate of ammonia a platina vibrator will operate with either positive or negative pole connected to the vibrator.

The motion of the vibrator may be made to record in ink dots and dashes by employing a small wheel inked by a fountain-wheel, and which is brought into contact with a moving strip of paper, or relieved therefrom by the movement of the vibrator.

I claim as my invention—

1. A moving surface in contact with a yielding vibrator, through which pulsations of electricity are passed when such surfaces in contact are of such a character that the friction will be varied by the electrical condition, substantially as set forth.

2. A vibrator, in combination with means for adjusting the pressure of the vibrator on the moving surface, and of the yielding force that moves the vibrator in the opposite direction to that derived from the moving surface, substantially as set forth.

3. The combination of a yielding vibrator, operated substantially as set forth, with a secondary circuit actuated by such vibrator, substantially as specified.

4. A telegraph instrument with a vibrator that is controlled by electro-chemical decomposition.

Signed by me this 7th day of August, A. D. 1874.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,402**, dated March 2, 1875; application filed June 1, 1874.

CASE No. 78.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphic Paper, of which the following is a specification:

Ferrocyanide, or yellow prussiate of potash, has been employed in the solution for the chemical paper used in telegraphing. This solution is not as sensitive as my improved solution.

I make use of ferridcyanide of potassium, or red prussiate of potash in solution. This material may be prepared by using about one part of ferrocyanide of potash to sixteen parts of water, through which solution chlorine gas is passed until it assumes a greenish red tinge. The paper for the telegraphic receiving-instrument is to be immersed in this solution of ferridcyanide of potassium, and I prefer that chloride of calcium be added to the solution. An iron pen or stylus is used in the receiving-instrument.

I claim as my invention—

The solution for chemical telegraph-paper prepared with ferridcyanide of potassium, substantially as set forth.

Signed by me this 29th day of September, A. D. 1873.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,403,** dated March 2, 1875; application filed June 1, 1874.

CASE No. 84.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Paper for Receiving-Telegraph Instruments, of which the following is a specification:

I employ tannin and hydrosulphuret of ammonia in water, and prefer to add a small quantity of chloride of sodium to increase the conductivity of the parts.

The tannin may be an extract of nut-galls, but pyrogallic acid or tannic acid may be employed.

I find the tincture of nut-galls about one-half ounce, five drops of hydrosulphuret of ammonia, and a pint of water, filtered, form a very sensitive solution for moistening paper for a telegraphic receiving-instrument.

I claim as my invention—

The solution for chemical telegraph-paper prepared with tannin and hydrosulphuret of ammonia, substantially as set forth.

Signed by me this 29th day of October, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,404**, dated March 2, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Paper for Receiving-Telegraph Instruments, of which the following is a specification:

I make use of a tincture of logwood to moisten the paper. I find that with an iron pen a mark is made upon the paper when the current passes. There is no mark when the electric circuit is broken.

Logwood is peculiarly sensitive to color in the presence of iron, and the electric action develops the color.

I find it advantageous to use chloride of sodium in the solution of tincture of logwood to promote the conductivity of the paper, but muriate of ammonia is preferable for this purpose. By adding to the aforesaid solution of logwood a small quantity of sulphate of iron, the solution is of such a light color that the paper remains nearly white, and the mark will be produced by a platina pen or stilus, to which the negative pole is connected.

I claim as my invention—

The solution for chemical telegraph-paper, prepared with tincture of logwood, substantially as set forth.

Signed by me this 29th day of September, A. D. 1873.

THOMAS A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

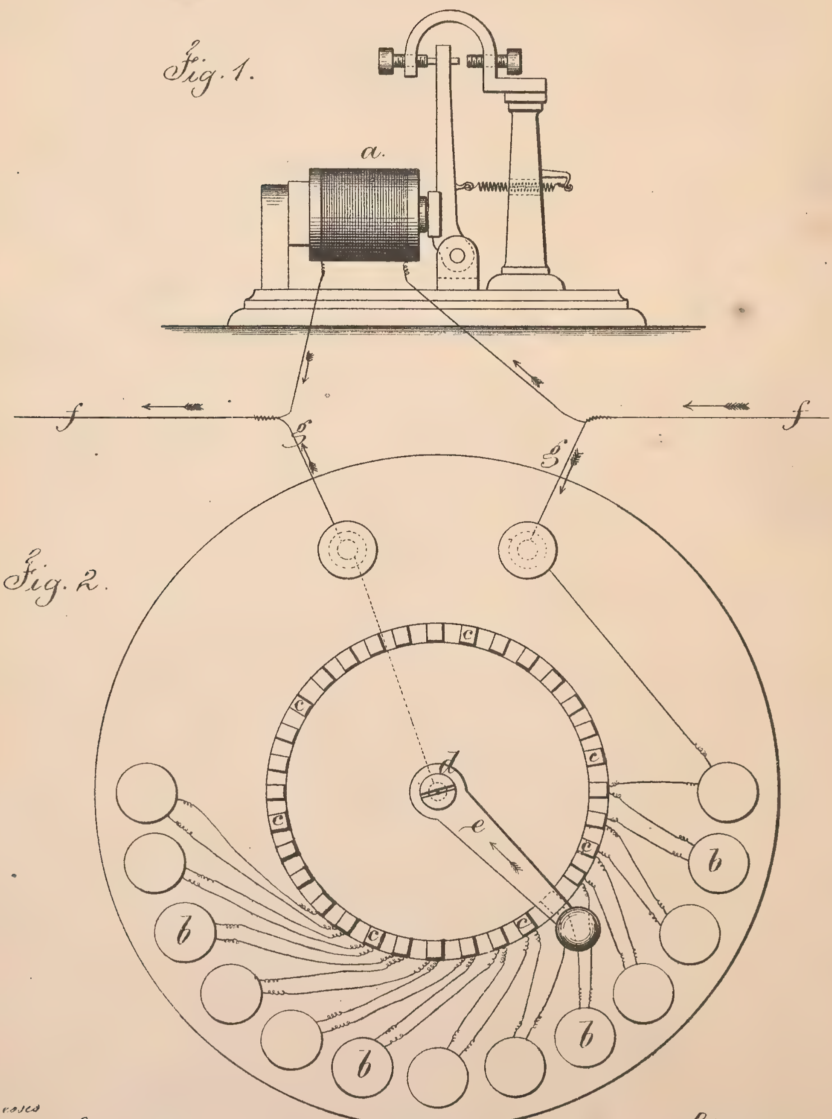
T. A. EDISON.

Adjustable Electro-Magnet for Relays, &c.

No. 160,405. Patented March 2, 1875.

Fig. 1.

Fig. 2.



Witnesses

Chas H Smith

Harold Serrell

Inventor

Thos. A. Edison

Lemuel W. Serrell

Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN ADJUSTABLE ELECTRO-MAGNETS FOR RELAYS, &c.

Specification forming part of Letters Patent No. **160,405**, dated March 2, 1875; application filed July 29, 1873.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Adjusting Electro-Magnets, of which the following is a specification:

With an electro-magnet employed for a sounder or receiving-instrument it is very difficult to adjust the action, because the intensity of the current varies greatly, and frequently false currents reach the magnet and prevent its proper action. To provide for these various circumstances, it is usual either to vary the tension of the retractile spring, or adjust the position of the armature and core in relation to each other.

My invention is made with reference to obtaining a uniformity of current in the electro-magnet, and avoiding the adjustment of the magnet or the parts thereof. I make use of a shunt or branch circuit connected at both sides of the electro-magnet, and in that shunt I place a regulator composed of several helices or resistance-coils connected to each other and to circuit-pins, and employ an arm that can be revolved upon a center and bring into the shunt greater or less resistance, and thereby directing the proper proportion of the current through the electro-magnet and allowing the remainder to pass through the shunt.

In the drawing, Figure 1 is a side view of the electro-magnet, and Fig. 2 is a plan of the shunt-regulator.

The electro-magnet *a* is of ordinary character, and employed as a sounder or otherwise. The shunt-regulator contains the resistance-coils *b b*, connected to each other through the circuit-pins *c c* in the center of which is the pivot *d* of the arm *e*. The line *f* is connected through the magnet *a* and by the shunt-wires *g* with the pivot *d* and first coil *b*.

If the arm *e* is turned so as only to include one coil *b* in the shunt, the resistance will be but little, and most of the current will pass by the shunt and but little through the electro-magnet *a*, and by turning this arm *e* any desired number of coils *b* will be included in the shunt, so that, as the resistance increases, so the proportion of current directed through the magnet *a* will increase also.

I do not claim a rheostat or adjustable resistance in a shunt-circuit, to regulate the current passing through a chemical receiving-instrument. I do not claim a shunt around an electro-magnet with a resistance that is not variable and serves to lessen the injury to the contact-points.

I claim as my invention—

The variable resistance *b*, placed in a shunt-circuit, in combination with an electro-magnet for equalizing action of the current in the electro-magnet and dispensing with the spring-adjustment, as set forth.

Signed by me this 23d day of April, A. D. 1873.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPH-PAPER.

Specification forming part of Letters Patent No. **160,580**, dated March 9, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Solutions for Chemical Telegraphic Paper, of which the following is a correct description:

I make use of about five pennyweights of aurichloride of sodium (double chloride of gold and sodium) to a pint of water, and about an ounce of nitrate of ammonia.

A small amount of bichloride of mercury increases the sensitiveness of the paper. This, however, may be omitted, and, in place of nitrate of ammonia, any other salt may be employed having a corresponding reaction with the aurichloride of sodium.

When an iron pen is used with the above solution, the mark on the paper is of a bluish tinge, and with a tin pen or stylus the mark is purple of cassius.

The above-mentioned solution is very sensitive to electric action, and is available in chemical telegraphs.

I claim as my invention—

The solution for chemical telegraph-paper prepared with aurichloride of sodium, substantially as set forth.

Signed by me this 14th day of October, 1873.

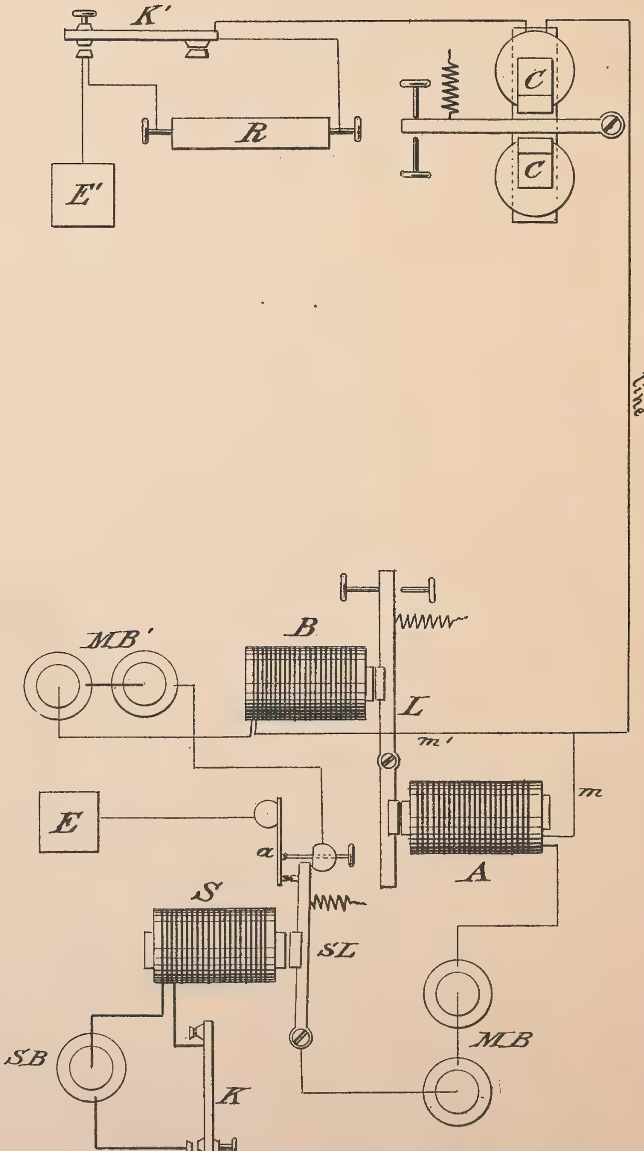
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex Telegraph.

No. 162,633. Patented April 27, 1875.



Witnesses:

Chas. Nida

C. Sedgwick

Inventor:

T. A. Edison

Per Munn & Co

Attorneys.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **162,633**, dated April 27, 1875; application filed April 26, 1873.

CASE H.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of the city of Newark, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Duplex-Telegraph Apparatus, of which the following is a specification:

The invention has for its object the simultaneous transmission of two different dispatches or signals over the same line-wire from opposite directions,

and the invention consists in the transmission of positive and negative currents over the line to effect the reception of one message, and the increase and decrease of the strengths of these currents, either positive or negative, to effect the reception of the other message.

The accompanying drawings represent a plan view of my improved apparatus in this case, part of the apparatus being placed at one end of the line and part at the other end.

A and B are electro-magnets of equal strength, and are placed at an equal distance from and on the opposite sides of the armature-lever L, pivoted between them. Both magnets are arranged with separate batteries. The battery M B is connected with the magnet A, and with its positive pole to the line, and the battery M B′ is connected with the magnet B, and has its negative pole to the line. The batteries M B and M B′ are alternately placed into the circuit by the sounder-lever S L and the double-spring contact *a*, which is in contact with the earth. The key-lever S L is operated, as usual, by the local battery S B, key K, and magnet S. The magnets A and B are connected to the main-line wire and polarized relay C by the wires *m* and *m*′. The polarized relay C, being either at the same station or at the distant station, is operated by the positive and negative currents sent over the line. K′ is a Morse key, and R a resistance-coil or rheostat, connected to the key K and earth E.

The object of the key K′ and rheostat R is to increase and decrease the strength of the current upon the line, so as to affect the lever of the relay A B. The increase and decrease in the strength of the line-current do not affect the polarized relay C, as this is dependent for working upon the direction of the current or polarity, independent of its strength, so that signals may be transmitted by S L, batteries M B and M B′, or by any other battery-reversing device, and these currents, acting upon the relay C, cause its tongue to be thrown to the right or left, according to the polarity of the current transmitted. At the same time another set of signals may be sent over the same wire by the depression of the key K′, which causes a decrease in the resistance of the line, and a consequent increase in the strength of the current on the line, and this increased strength of current produces sufficient magnetism in either A or B to overcome the attraction of its spring, and it is drawn toward the magnets.

On closing the key K the magnet attracts the lever S L, throwing the battery M B′ and magnet B out of circuit, and the magnet B and battery M B, with its positive pole, is placed in circuit and toward the line. In a like manner, when the key-lever is not attracted by its magnet, the magnet A and battery M B is thrown out of circuit, and the magnet B and battery M B′, with its negative pole toward the line, is thrown in circuit, the armature-lever L remaining constantly attracted (if K′ be closed) by either A or B, as the instantaneous transfer of polarity permits no separation of the same.

If both positive and negative currents were passed through one magnet only, a charge and discharge would be produced with a change of polarity in the iron cores, and the armature would be drawn away from the cores of the magnet for an instant by its retractile spring, at the moment when the cores were changing their polarity. In this arrangement the wires upon the magnets, connections, and arrangement of batteries are such that the polarity of both magnets are never changed.

The polarized relay is self-adjustable, and follows the positive and negative currents, whether the tension of the same is suddenly increased or decreased.

The polarized relay C can be placed at a number of stations on the line, and each will

be able to receive the signals from the stations, transmitting positive and negative currents. The relay A B may also be placed at a number of stations, if A or B be dispensed with, and other devices applied to prevent the mutilation of the signals by change in the polarity of its iron core.

I claim as new and desire to secure by Letters Patent—

1. The armature-lever L, pivoted between the magnets A and B, and operated by an increase and decrease in the tension of the line-current, in combination with the key K′ and rheostat R, for the purpose set forth.

2. The sounder-lever S L, double-spring contact *a*, and batteries M B and M B′, arranged substantially as set forth, and for the purpose specified.

3. The combination, with the main-line circuit, of a receiving-instrument operated by changes in the polarity of the current independently of tension, with another receiving-instrument operated by changes of tension independent of polarity, means of changing the polarity of the current, and means of changing the tension of the current, substantially as and for the purpose specified.

THOMAS A. EDISON.

Witnesses:

PAUL GOEPEL,

T. B. MOSHER.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,859**, dated August 17, 1875; application filed July 25, 1874.

CASE NO. 88.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electric decomposition for telegraphing.

The invention consists in forming the decomposing stylus or pen of tellurium and wetting the paper with water or any liquid conductor. I prefer water to which has been added a quantity of hydrate lime or potash.

If the stylus, tipped with tellurium, is connected to the zinc end of a battery, and the drum or plate upon which the moistened paper rests be connected to the copper end of the battery, hydrogen is evolved at the point where the tellurium touches the paper. The hydrogen combines with the tellurium to form hydrotelluric acid, which has a red color, but is instantly decomposed in contact with the air, and forms a black pigment, which is permanent. I have found that this reaction is more delicate than that of iodide of potassium, which is the most delicate known in chemistry. This decomposition of tellurium has the peculiar characteristic over all other metals that it produces the mark with hydrogen, and also that the mark, at its first formation, is not a precipitate like the ferrocyanide of iron when an iron pen and ferrocyanide of potassium are used, which has a tendency to adhere to the stylus after the current has ceased, and produce attenuation of the signals; but the permanent color is formed by the action of the air after the decomposition has taken place: hence the signals will be much sharper.

I claim as my invention—

1. The method of recording telegraph or other signals by the electro-decomposition upon moistened paper or other material of a stylus of tellurium.

2. A paper moistened with hydrates of lime, potash, or the cyanides of potassium, for use with a tellurium stylus, for the purpose set forth.

Signed by me this 1st day of June, A. D. 1874.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,860**, dated August 17, 1875; application filed July 25, 1874.

CASE No. 89.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electro-decomposition for telegraphic purposes.

The invention consists in combining the sesquichloride of iron with the ferrocyanide of potassium, and using a stylus of tin, which is connected to the copper pole of the battery.

The action is as follows: Nascent oxygen evolved at the point of the tin stylus combines with the stylus to form the protoxide of tin, which is a powerful reducing agent. This reduces the sesquisalt of iron to a protosalt of iron, and the ferrocyanide of potassium combines to form a precipitate of Prussian blue. The reaction is very delicate. Chloride of ammonium or sodium increases the delicacy.

I claim as my invention—

The combination of a sesquisalt of iron with the ferrocyanide of potassium, and a tin stylus, for the purpose set forth.

Signed by me this 1st day of June, A. D. 1874.

THOS. E. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN CHEMICAL TELEGRAPHY.

Specification forming part of Letters Patent No. **166,861,** dated August 17, 1875; application filed July 25, 1874.

CASE No. 90.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Chemical Telegraphs, of which the following is a specification:

The object of this invention is to record dots and dashes upon chemically-prepared paper by electro-decomposition for telegraphic purposes.

The invention consists in combining a protosalt of iron with the sulpho-cyanide of potassium, in which the paper is to be moistened. The recording-stylus is formed of platinum, or metal that is not oxidized by the nascent oxygen.

The action is as follows: When the copper end of a galvanic battery is connected to the platina stylus, resting on the paper that is moistened in the above solution, and the zinc end is connected to the metal upon which it rests, oxygen is evolved at the platina point. This raises the protoxide to a sesquioxide or peroxide, when the sulpho-cyanide of potassium, which has no action on a protosalt of iron, combines with the higher oxide to form the blood-red sulpho-cyanide of iron.

The reaction is very delicate. I prefer to use the protosalt of iron in the form of the protosulphate of iron. Chloride of sodium added to the solution increases the delicacy.

I claim as my invention—

The combination of a protosalt of iron, sulpho-cyanide of potassium, and a non-oxidizable stylus, for the purposes set forth.

Signed by me this 1st day of June, A. D. 1874.

THOS. A. EDISON.

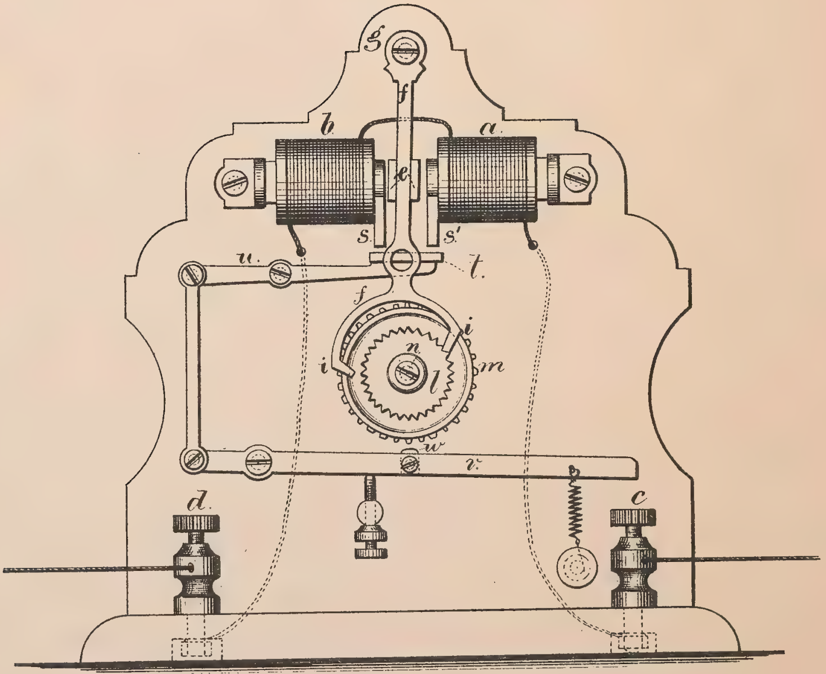
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Printing-Telegraph.

No. 168,004.

Patented Sept. 21, 1875.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thos A. Edison.

per Lemuel W. Serrell

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE GOLD AND STOCK TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. **168,004**, dated September 21, 1875; application filed June 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Printing-Telegraphs, of which the following is a specification:

Two electro-magnets operating upon an armature have been used, and the magnets have been charged with pulsations of alternate opposite polarity, and the armature has acted to move the type-wheel.

My present invention relates to this class of printing-telegraphs; and consists in an arrangement of armatures, electro-magnets, type-wheel, and printing-lever, so that the printing is effected by the same magnets that set the type-wheel when a pause occurs in transmitting currents of alternate opposite polarity.

In the drawing I have represented, by an elevation, the instrument as arranged by me.

The electro-magnets *a b* are in the main-line circuits that connect with the binding-screws *c d*, and between the cores of these magnets is the armature *e*, that is by preference made double, and upon opposite sides of the lever *f* that has its fulcrum at *g*, and is provided with wedge-acting pallets *i i*, operating upon the ratchet-wheel *l*, shaft *n*, and type-wheel *m* to rotate the same. The cores of the electro-magnets are extended laterally, as at *s s'*, and an armature, *t*, is provided upon the lever *u*, that is connected with the printing-lever *v*. The pulsations sent over the line are of alternate opposite polarity, so that the armature *e* will be repelled from the magnet, with which it is in contact, as the current of opposite polarity enters the helix, and the armature and lever by their momentum (from repulsion) are thrown toward the opposite magnet, and the armature is attracted thereby. In this manner the type-wheel pallets will be moved with as great rapidity as the pulsations of alternating polarity can be sent. The armature *t*, however, will not be attracted because the magnetic energy of one polarity does not accumulate sufficiently before the pulsation of opposite polarity is introduced; but when a slight pause occurs on a closed circuit the armature *t* is attracted, and the printing-lever is moved, and the impression made by the pad *w*, pressing the paper toward the type-wheel.

The mechanism for moving the paper forms no part of my invention, and may be of any desired character.

I claim as my invention—

1. Two electro-magnets in the electric circuit, with an armature moved between their cores in consequence of reversing the polarity of the pulsations, such armature actuating the lever and type-wheel, in combination with the lateral cores of the electro-magnet and the armature that operates the printing-lever, as set forth.

2. The arrangement of the type-wheel lever and armature between two electro-magnets, and an armature and lever at one side of the type-wheel, operating an impression-pad at the opposite side of the type-wheel, substantially as set forth.

Signed by me this 22d day of May, A. D. 1874.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Transmitter and Receiver for Automatic Telegraphs.

No. 168,242. Patented Sept. 28, 1875.

Fig. 1.

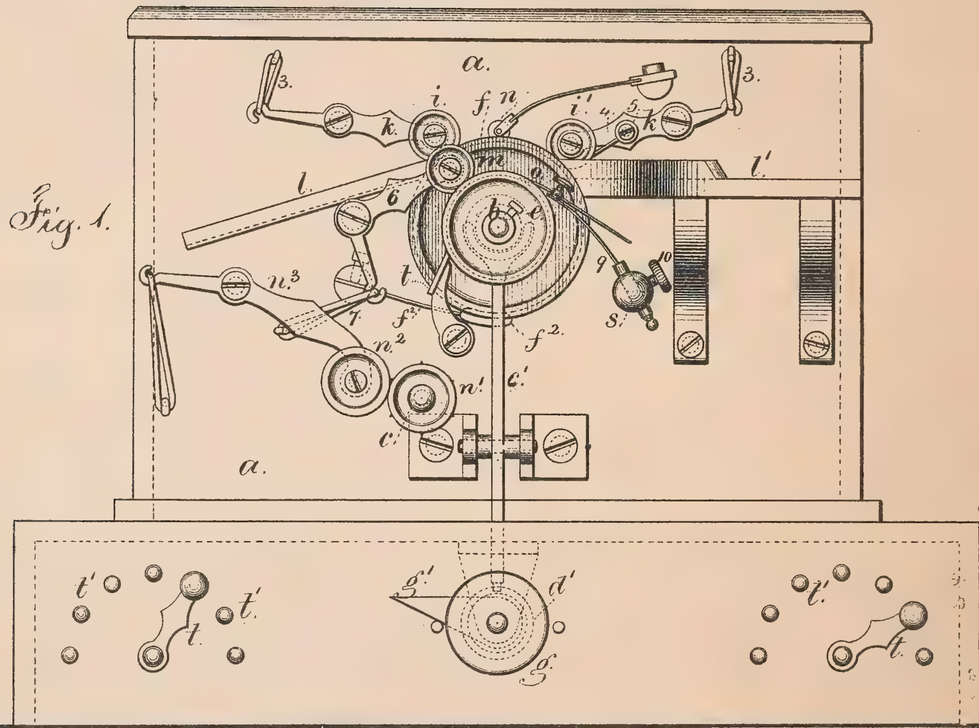


Fig. 2.

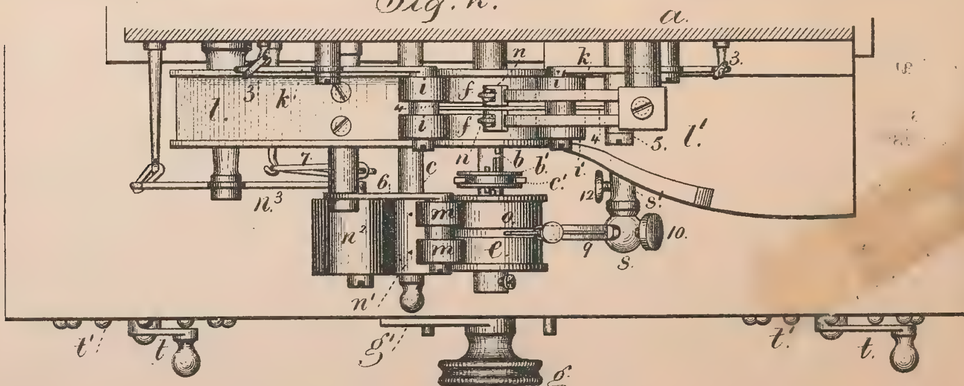
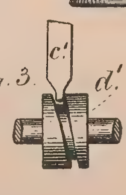


Fig. 3.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TRANSMITTERS AND RECEIVERS FOR AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **168,242**, dated September 28, 1875; application filed January 26, 1875.

CASE 104.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic-Telegraph Instruments, of which the following is a specification:

This instrument is made for drawing through perforated paper and transmitting pulsations, or for moving the chemical prepared strip of paper, and winding the same up ready for transfer to the copyist to write out or print the message. My improvement has special reference to the mechanism by means of which these operations of transmitting and receiving are performed in one instrument.

In the drawing, Figure 1 is an elevation of said instrument, and Fig. 2 is a plan of the same.

Within the box *a* there is to be placed any suitable clock movement or mechanism, operated by a weight or spring to propel the shafts *b* and *c* with the required velocity. This clock-work is not shown in the drawings, as it may be of any convenient character, and it should include stopping and starting mechanism. The drums *e* and *f* are loose upon the shaft *b*, but there is between them a coupling, *b*′, sliding upon a feather or key, and connecting either *e* or *f* to the shaft *b*, so that it will be revolved by and with such shaft; and this coupling is operated by a lever, *c*′, at the lower end of which is a finger passing into the screw-cam *d*′, (shown detached in Fig. 3,) that is connected with the button *g* and pointer *g*′, so that by turning such button the drum *e*, for chemical paper, will be connected to the shaft and revolved, or the drum *f*, for perforated paper. The spring friction-brake *f*′ holds the drum *f* from turning when the paper is not to be run through, and this brake also serves to keep the surface of the drum clean. The contact-rollers *i* and *i*′ serve to press the perforated paper to the drum *f*, so that it may be drawn through by the revolution of said drum. These rollers are on levers *k*, that are acted upon by springs 3, and there is a guide-wire, 4, that extends from a stud, 5, on *k*, beneath the rollers *i i*′, and these rollers are grooved for its passage, and this wire serves to direct the advancing end of the strip of paper to the roller *i*. The troughs *l l*′, at opposite sides of the drum *f*, serve to guide the paper as it is entered and passes away, and the rollers *n* upon spring-arm close contact through the holes in the strip to transmit the pulsations, as heretofore usual. The strip of chemical paper is passed beneath the stylus *o*, over the drum *e*, beneath the contact-roller *m*, and is wound upon the roller n^1. The contact-roller *m* is upon an arm or lever, 6, that is provided with a spring, 7, and the stylus *o* is upon a spring-arm, 9, that is made with a stock that can be moved in a small head, *s*, and clamped by a screw, 10, so as to be adjusted lengthwise, and this head *s* has a stem running into the horizontal column *s*′, and clamped by the screw 12, to regulate the pressure of the stylus upon the paper. The cleaning-plate *t*, having a tongue passing into a groove in the drum *e*, prevents the paper sticking to the said drum. This has heretofore been used, and the end of the strip, coming into contact with the roller n^1, is pressed to the same by the roller n^2 and spring-lever n^3, and said paper is caused to adhere to the roller n^1 by small points that are upon its surface; hence the paper will be carried around and wound upon this roller n^1, and the roller n^2 will yield as the roll of paper increases in size. As heretofore explained, the shaft *c*, upon which this roller n^1 is placed, is revolved by the clock-work, so that it will act to wind up the paper; but as the roll increases in diameter the speed of winding would increase. This, however, is allowed for by friction between the surface of the shaft *c* and the interior of the central hole of said roller n^1, as the roller is simply placed upon this shaft; and this construction allows the roller to be removed with the paper upon it when the message is finished, or the paper has accumulated in a roll of sufficient size. This removable roller and its paper are taken by the person who writes out or prints the message from the chemically-marked strip.

The transmitting-roller being larger than the receiving-roller, and both making the same

number of revolutions, the perforated paper will be moved more rapidly than the chemical paper, so that the marks on the chemical paper will be contracted proportionately, and the length of the chemical paper lessened to the proper extent.

The circuit-connections to the instrument are to be of any desired character. It is generally preferable to connect the stylus *o* and the rollers *n* with the line and the instrument to the earth, and to throw back either the stylus or the rollers that are not in use.

The switches *t* and pins *t′* serve to place upon the line greater or less resisting power under arrangements of circuits adapted to automatic telegraphy.

I claim as my invention—

1. The transmitting-drum *f* and receiving-drum *e* upon the same shaft, in combination with the receiving and transmitting stylus or rollers *n o* and a clutch, *b′*, for connecting either one drum or the other to the shaft *b*, as set forth.

2. The two contact-rollers *i* and *i′*, applied to the transmitting-drum, one at each side of the roller *n* or stylus, in combination with the wire 4, to guide the advancing end of the strip of paper, as set forth.

3. The roller n^1, removable from the shaft *c*, and revolved by friction, and containing points, in combination with the receiving-drum *e* and yielding roller n^2, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

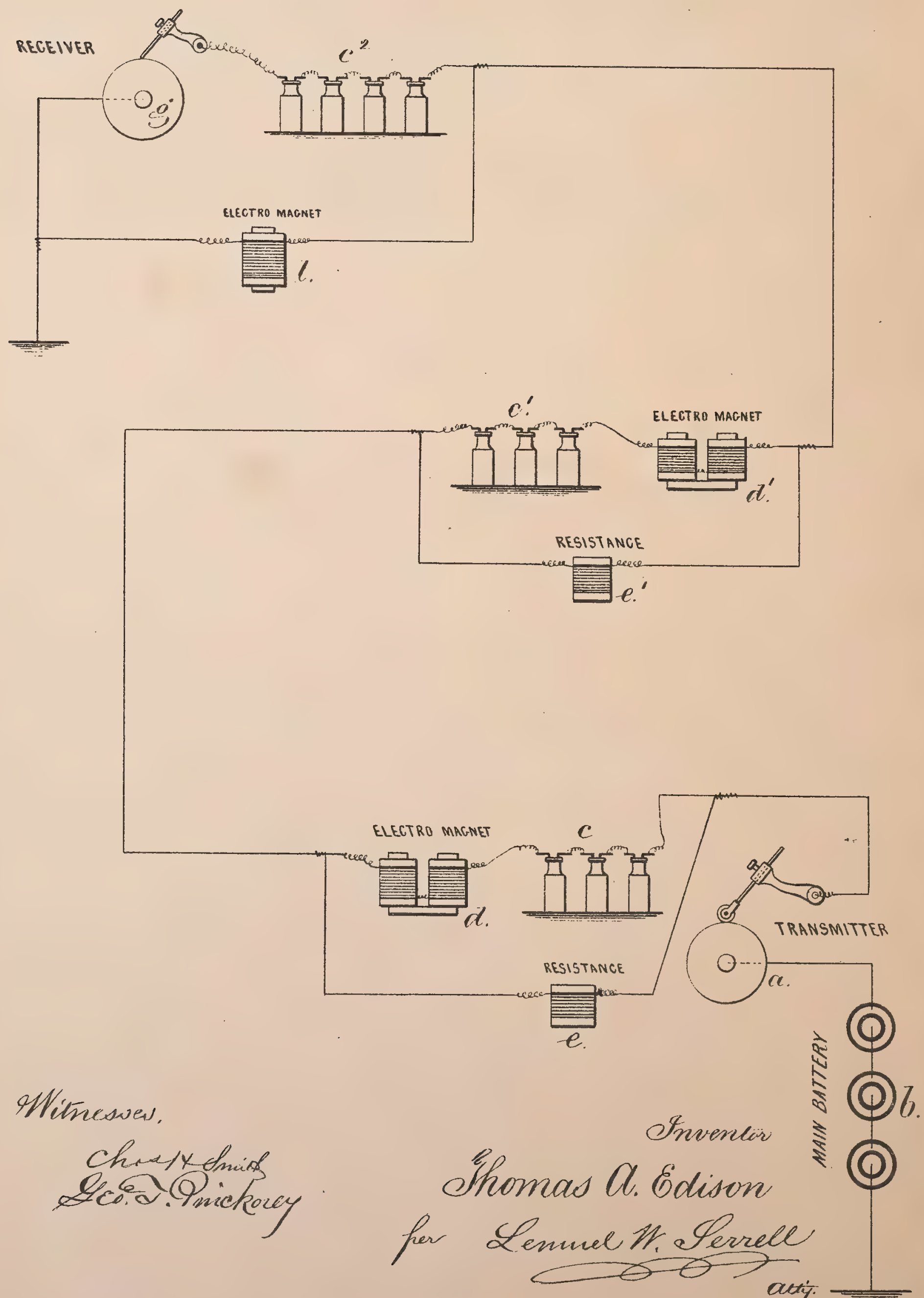
GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.

Automatic Telegraph.

No. 168,243. Patented Sept. 28, 1875.



Witnesses,

Chas H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **168,243,** dated September 28, 1875; application filed January 26, 1875.

CASE 103.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to obtain more powerful action at the chemical receiving-instruments, and to obtain a more powerful compensation for the static currents of the line, and also to neutralize the reactionary or secondary currents from electro-magnets introduced in the line.

It is well known that when a secondary battery, made of cells containing acidulated water and two metals of the same character, is introduced into a main circuit, the secondary battery sets up a current in the same direction as a current passing through that secondary battery from the main battery, thus intensifying the pulsations on the line; and that when the circuit to the main battery is broken, the secondary battery sets up a current in the opposite direction. The action of an electro-magnet is the reverse, as such electro-magnet sets up a current opposed to the main current when the circuit is closed, and in the same direction when the circuit is interrupted or broken.

I make use of an electro-magnet contiguous to the chemical receiving-instrument, for compensating or neutralizing the static discharge of the line, as set forth in my Patent No. 135,531, and I employ the secondary battery aforesaid in addition, to insure more distinct pulsations at the receiving-instrument. With signaling electro-magnets or sounders placed in the main line, I use the said secondary batteries to neutralize the effects of such electro-magnets in the line when they discharge.

In the diagram, the transmitter *a* is shown for perforated paper; but it may be of any desired character. The main battery *b* is connected with the earth and transmitter. The secondary battery *c*, of acidulated water in cells, also containing similar metallic poles, is placed in the main line. *d* is an electro-magnet, which may be of a relay or sounder, and *e* is a resistance, which should be an adjustable rheostat in a shunt around the receiving-instrument and secondary battery. These parts are duplicated at c^1, d', and e', and it is to be understood that they may be used at any number of intermediate stations. In each instance the secondary battery augments the power of the pulsation sent from the main battery sufficiently to make up for the resistance of the magnets or line.

The rheostat *e* or e' causes the proper proportion of current to pass through *c d*, and as the electro-magnet discharges, upon breaking the main circuit, a path is provided for the same in the local circuit, so that it will not pass out upon the line and interfere with or mutilate the signals, and the discharge of the secondary battery neutralizes the static charge of the line and the discharge of the electro-magnet by opposing the same.

By this arrangement intermediate relays and sounders can be introduced without interfering with the rapid pulsations on the main line.

At the chemical receiving-instrument *g* the secondary battery c^2 is used to intensify the pulsation on the main line, and produce a distinct mark, and also, by its discharge, to neutralize the static discharge from the line; and the electro-magnet *l* is introduced in a branch around the receiving-instrument to set up a secondary or reactionary current, to aid in neutralizing the static discharge from the line, as in aforesaid patent.

This magnet also serves as a resistance to direct a portion of the current through the chemical paper.

I claim as my invention—

1. The secondary battery, with poles of similar materials, applied in the main circuit, containing the receiving-instrument, in combination with a shunt around the receiving-instrument, containing a resistance or electro-magnet, for the purposes set forth.

2. The combination, with the signaling electro-magnet, placed in the line, of a secondary battery, also in the line, and a shunt around such instrument, containing a resistance, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

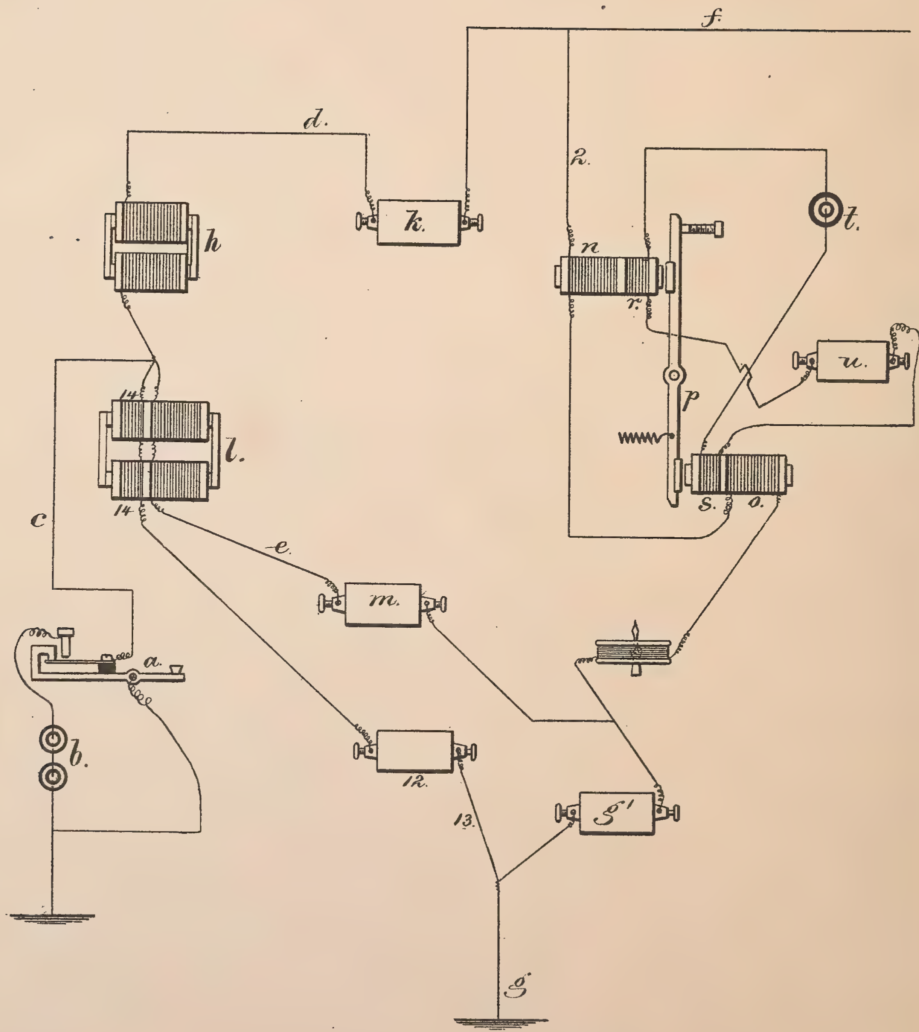
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Duplex Telegraph.

No. 168,385. Patented Oct. 5, 1875.



Witnesses

Chas H. Smith

Geo. T. Pinckney

Thomas A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

DUPLEX TELEGRAPH.

Disclaimer forming part of Letters Patent No. **168,385**, dated October 5, 1875; Disclaimer filed November 16, 1878.

To the Commissioner of Patents:

Your petitioner, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, represents that Letters Patent No. 168,385, dated October 5, 1875, were duly granted to him for improvement in duplex telegraphs, the same being known as Case 111; that he has reason to believe that, through inadvertence, accident, or mistake, the specification or claim in the said Letters Patent might be considered as broader than was originally intended by him. He therefore hereby enters the following disclaimer, to the extent of his interest therein, which is the entire patent, saving and excepting any contract claims which may be alleged by others.

"I do not herein claim an electro-magnetic coil placed in the artificial line and acting to neutralize the effect of the static discharge, as the same is set forth in a previous application made by me September 1, 1874, and known as 'Case 97.'"

THOMAS A. EDISON.

Witness:

STOCKTON L. GRIFFIN.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,465**, dated October 5, 1875; application filed January 15, 1875.

CASE 102.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphic Solutions, of which the following is a specification:

I have found that if a colored salt of aniline, preferably rosaniline, known in commerce as magenta, which dissolves in water to a deep red, be treated with nitric acid, or, preferably, red fuming nitrous acid, it is oxidized to a nearly colorless solution. If a piece of paper is moistened in this solution and used in a chemical-telegraph recording-instrument, beautiful red marks are obtained when the positive pole of the battery is connected to the decomposing-pen, which is preferably of tin. The nascent oxygen in electrolysis combines with the tin pen to form protoxide of tin, which is a powerful reducing agent, and the colorless compound of oxidized rosaniline is decomposed, leaving it in its original state, viz., deep red. By the action of the air these marks soon become more apparent and of a deep violet. It is a very sensitive reaction, being as delicate as the iodide-of-potassium solution, but with the advantage of permanent marks and economy.

If an easily-decomposed chloride of any metal be added, the delicacy of the reaction is greatly increased, as the nascent chlorine, combining with the tin to form a protochloride, is a more powerful reducing agent than the protoxide. The delicacy of the reaction is still further increased by adding an organic acid, preferably oxalic.

A great number of the salts or compounds of aniline may be rendered colorless by oxidation and reduced to their original state, as set forth; but I prefer magenta, or rosaniline, on account of its superior coloring properties.

I claim as my invention—

A chemical solution for telegraphic paper containing aniline in a colorless, or nearly colorless, condition, substantially as set forth, in order that the mark may be made by electrolysis, as specified.

Signed by me this 14th day of August, A. D. 1875.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN SOLUTIONS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,466**, dated October 5, 1875; application filed January 26, 1875.

CASE 106.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Preparing Paper for Chemical Telegraphs, of which the following is a specification:

I have found that if a protosalt of iron be combined with vegetable astringents, such as tannin or its derivatives, gallic or pyrogallic acid, scarcely any coloration follows; but if a piece of paper be moistened with this solution and placed under the recording-point, the nascent oxygen due to electrolysis raises the protosalt of iron to a higher oxide, with which the vegetable astringents combine to form intense inky compounds. The addition of nitrate of ammonia, or any salt which does not precipitate, increases the delicacy of the reaction, by reducing the resistance of the paper. The addition of a vegetable acid, such as oxalic acid, also increases the delicacy. I prefer to use a platina decomposing-point. It does not matter what the proportions of the various substances are as long as they are in excess of that necessary to produce the full amount of reaction. I prefer to use protochloride of iron, pyrogallic acid, nitrate of ammonia, and oxalic acid.

I claim—

In a chemical solution for telegraphic paper, the combination of a protosalt of iron with a vegetable astringent and a conducting salt, substantially as set forth, in order that the mark may be made by electrolysis, as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN RECORDING-POINTS FOR CHEMICAL TELEGRAPHS.

Specification forming part of Letters Patent No. **168,467**, dated October 5, 1875; application filed January 26, 1875.

CASE 105.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Recording-Points for Chemical Telegraphs, of which the following is a specification:

I have found that if the decomposing and recording point of a chemical telegraph be made of metallic ruthinium, and connected to the positive pole of the battery, a coloration is made upon nearly dry paper, which had been moistened with various chemical solutions, preferably ferro-cyanide of potassium and chloride of sodium. The reaction is of extreme delicacy, the marks being due probably to the finely-divided oxide of ruthinium formed by the electrolytic oxygen.

I claim—

A recording-point formed of metallic ruthinium in a chemical telegraph, substantially as set forth.

Signed by me this 18th day of January, A. D. 1875.

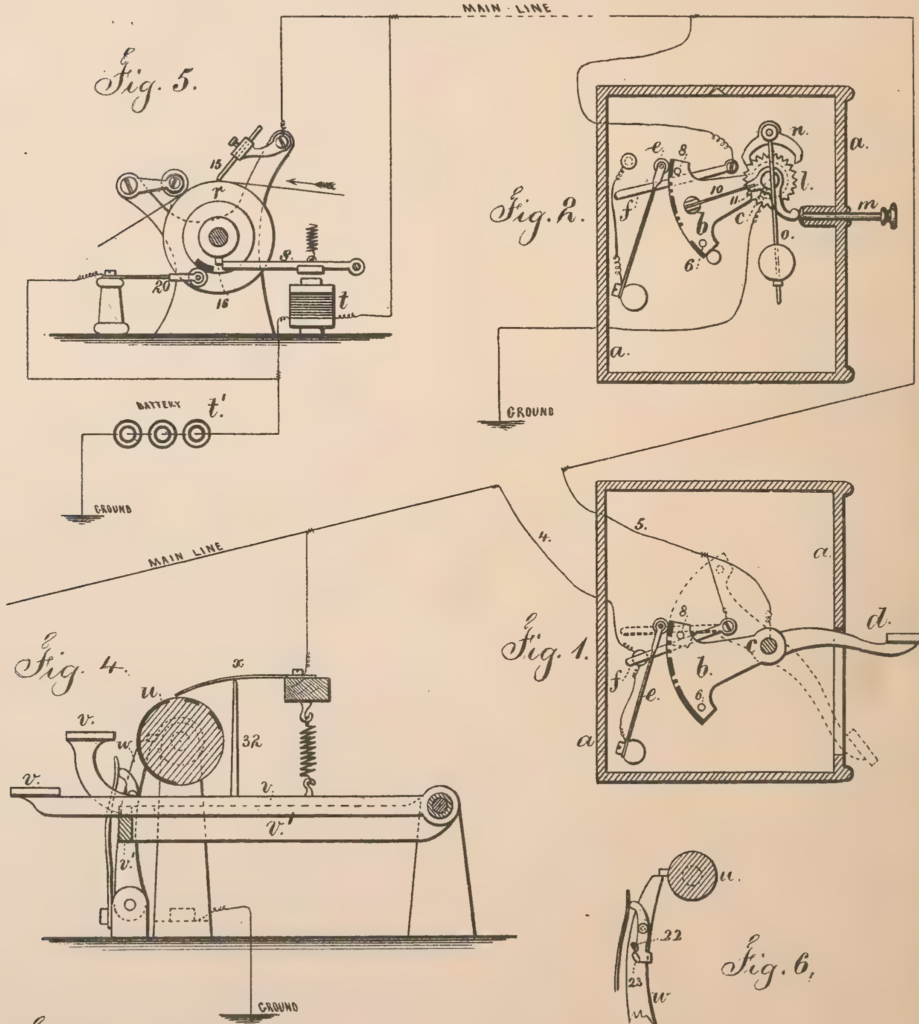
THOS. A. EDISON.

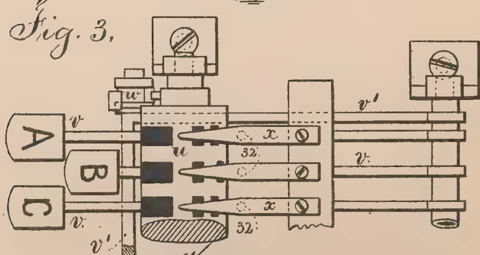
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON & C. BATCHELOR.

ELECTRIC SIGNALING-INSTRUMENT.

No. 169,972. Patented Nov. 16, 1875.





Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventors
Thomas A. Edison.
Charles Batchelor.
for Lemuel W. Serrell
Atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON AND CHARLES BATCHELOR, OF NEWARK, N. J.

IMPROVEMENT IN ELECTRIC-SIGNALING INSTRUMENTS.

Specification forming part of Letters Patent No. **169,972**, dated November 16, 1875; application filed March 23, 1875.

To all whom it may concern:

Be it known that we, THOMAS A. EDISON and CHARLES BATCHELOR, both of Newark, in the State of New Jersey, have invented an Improvement in Electric Telegraphs; and the following is hereby declared to be a full, clear, and exact description of the same.

This telegraph apparatus is made for local or private lines, and for alarms and messenger calls, and is known as the district alarm or domestic telegraph.

An instrument adapted to such uses has to be simple, inexpensive, durable, not easily deranged or put out of working condition, and, withal, reliable in the signal sent.

We make use of a segmental weighted lever with conducting and non-conducting spaces upon its surface, so that by moving the segment in contact with a circuit-closing spring or roller, the signal will be given, and the same is received at the central station by taps on a bell or sounder, or upon chemical paper. An instrument of this general character is shown in Edison's Patent No. 154,788. We use, in connection with this district telegraph, chemical paper, upon which the mark is made by electrical decomposition, as heretofore well known; and we employ in that connection automatic mechanism that sets the paper in motion, and peculiar devices for opening and closing the circuits in connection with the transmitting-segments.

As an additional convenience, a simple finger-key instrument is sometimes employed to spell out the communication letter by letter, especially upon local and private lines.

In the drawing, Figure 1 represents one of the transmitting-instruments adapted to giving a signal in one direction only as the key is restored, instead of giving it in reverse as the key is liberated, as in aforesaid patent. Fig. 2 represents the signaling-instrument with a regulator to determine the speed of movement. Figs. 3 and 4 are a partial plan and side view of the finger-key transmitter, and Fig. 5 represents the instruments at the receiving-station.

These all are shown with circuit-wire connections to illustrate the manner in which the pulsations reach the central station without interfering with other instruments.

The small box or case *a* is adapted to being hung or fastened up against a wall, door-post, or window-frame, and within it is the segmental weight *b*, that is made to swing upon the axis or shaft *c*, and is raised by the lever or key *d*, and drops by its own weight. At the curved edge of this segment there are pieces of non-conducting material, such as hard rubber, inserted, so as to open and close the circuit through the spring *e* when the segment is moved, and these conducting and non-conducting surfaces are such that the pulsations will be sent in the prearranged order and length to denote numbers or other signs at the receiving-station, and, in some instances, two or more of these transmitting segmental weights are employed side by side in the same instrument to send different prearranged signals. A lever-switch, *f*, is introduced between the line connections 4 and 5, so that the circuit will remain closed between 4 and 5, and no pulsation will be made as the segment *b* is raised; but just as the segment reaches its upward movement, a pin, 6, lifts the switch *f*, and the electric circuit is broken between 4 and 5, so that the pulsations will be sent on the line as the segment *b* descends, and opens and closes the circuit through *b* and *e*, and the signal will thus pass to the central station. A pin, 8, restores the switch *f* to place as the segment *b* completes its downward movement.

The same thing is effected by the instrument, Fig. 2; but the main line is tapped by a branch circuit passing to the earth. This circuit, in a normal condition, is broken by the switch *f*, and that switch is moved by the pin 6 upon the extreme upward movement of the segment, so that the circuit will be complete through the spring *e*, segment *b*, and base of the instrument to the earth, and the pulsations will be made by the alternate conducting and non-conducting surfaces as the segment *b* falls. At the extreme downward movement the pin 8 moves the switch and opens the branch circuit to earth.

In order to prevent a sudden movement of the segment *b* we apply on the same shaft *c* the ratchet-wheel *l*, that is only connected to the segment *b* through the spring 10, and a yoke, 11, upon this ratchet-wheel is formed

with a lever end, to be pressed upon by the finger or by a slide-rod, *m*, and there is a pallet-escapement, *n*, and a pendulum-vibrator, *o*, which is operated by the ratchet-wheel as the segment *b* is forced up and as it falls, and prevents too rapid movement of the segment; but the spring 10 lessens the irregular movement of the segment *b*, which would result if the wheel *l* was firmly attached to the segment *b*.

At the central receiving-station the instrument is provided with a drum, *r*, over which the strip of chemically-prepared paper passes, and upon this paper the stylus 15 rests, so that a mark will be made by the electricity as it passes, and this drum is held from revolving by the armature-lever *s* and stop 16.

When the circuit is closed at the sending-station the current first passes through the magnet *t*, attracting the armature and lever, and liberating the stop 16, so that the drum *r* is instantly set in motion by clock-work and a weight or spring, so that the paper will be moved along beneath the stylus 15, and be marked by the passage of the electricity. The spring 20 rests upon a non-conducting surface, so that when the drum *r* has made one revolution and stops with the pin 16 against the armature-lever *s*, the circuit through the stylus is broken, thus compelling the first pulsation to act in the magnet *t*. The battery is shown at *t'*.

The transmitting key-instrument (shown in Figs. 3 and 4) is made with a cylinder, *u*, the surface of which is provided with conducting and non-conducting substances in lines around the periphery, as has heretofore been used, and this is driven by clock-work when liberated by depressing one of the keys *v*. The key acts upon the swinging frame *v'* to move that down, and, by an inclined finger, 22, press back the spring-stop *w*, so that the cylinder *u* will be liberated and revolved by the clock-work, and then the stop springs back to place upon the upward movement of the frame *v'*, and its finger 22 passes behind a spring projection, 23, on *w*, (see Fig. 6,) so that the stop *w* remains in place to prevent more than one revolution of the cylinder *u*.

One wire of the line passes to the journals of the cylinder *u*, and the other to the range of transmitting-springs *x*, and these are held up from the surface of the cylinder by the non-conducting studs 32; but when a key is depressed its spring *x* rests upon the surface of the cylinder, and as the latter revolves the pulsations of electricity are made to indicate the letter of the key.

We claim as our invention—

1. The combination, with the segmental circuit-closing weight, of the switch *f*, for the purposes set forth.

2. The combination, with the circuit-closing segmental weight, of the ratchet-wheel *l*, escapement *n*, pendulum *o*, and spring 10, for the purposes set forth.

3. The receiving-instrument, composed of a drum and stylus for chemical paper, and electro-magnet and armature-lever stop, and a circuit-closer insulated from the drum when the parts are at rest, for the purposes set forth.

4. The combination, with the circuit-closing cylinder *u* and keys *v*, of the springs *x*, held up by the studs 32, and the stop *w*, actuated by the frame *v'*, substantially as set forth.

Signed by us this 24th day of February, A. D. 1875.

THOS. A. EDISON.
CHAS. BATCHELOR.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

TELEGRAPH APPARATUS.

No. 171,273. Patented Dec. 21, 1875.

Fig. 1.

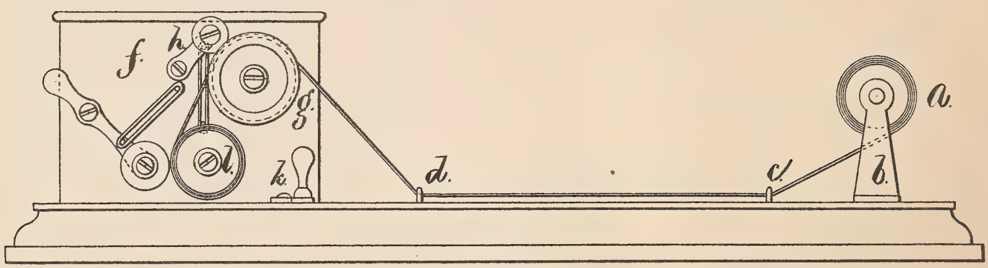
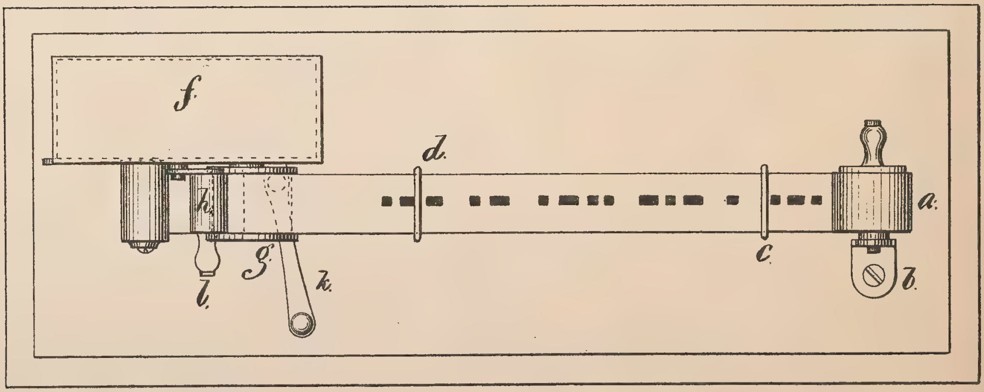


Fig. 2.



Witnesses
Geo. D. Walker
Geo. T. Pinckney

Inventor.
Thomas A. Edison
per Lemuel W. Serrell
atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **171,273**, dated December 21, 1875; application filed February 16, 1875.

CASE 110.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Telegraphic Apparatus, of which the following is a specification:

In the chemical telegraph it is usual to write out the messages either by hand or by a type-writing machine, and the person performing this work has to draw the strip along with one hand from time to time as the transcribing progresses. The same is true with the Morse system, where the message is not written out as it is received. With the damp chemical paper great inconvenience is experienced in handling loose hanks and bunches.

My improvements contemplate the use of a roll of paper. As the message is received the strip of paper is to be wound upon a roller, and then rewound to bring the commencement of the message outward upon the roll. The strip of paper is then drawn along in front of the operator at the average speed at which the copying can be effected, and the paper is wound upon a roller, so as to be in a compact form for storage, if it is necessary to keep them.

In the drawing, Figure 1 is an elevation, and Fig. 2 is a plan, of the improved apparatus.

The roller *a*, upon which the strip of paper containing the message is wound, is placed upon a gudgeon or shaft supported by a standard, *b*, and the strip of paper is passed beneath the guide-loops *c d*, that allow such strip to be drawn along freely from right to left, and in front of the operator that transcribes or writes out the message upon the table or rest contiguous to such strip. The paper is drawn along by a train of gearing or clock-work contained within a suitable frame or box, *f*, and driven by a weight or spring, and *g* is a drum moved by one of the shafts of such train of gearing, and *h* is a yielding contact-roller, so that the strip of paper which passes between *g* and *h* will be moved along regularly, and a lever, *k*, is provided to operate a friction-clamp, by means of which the speed may be regulated to suit the operator. If desired, the strip of paper might be delivered into a basket; but I prefer to wind it automatically by a roller, *l*, that is placed upon the projecting end of one of the shafts and driven by friction, so as to wind upon itself the strip of paper as delivered. It is preferable to employ a yielding contact-roller to press the paper upon the said roller, and if there are a few points upon the surface of this roller *l* the advancing end of this strip of paper will be caught and wound up without requiring the attention of the operator.

It will be apparent that the power employed for revolving the roller upon which the paper is wound may be derived from an electric engine, or from any other source, such as a treadle or other device worked by the foot.

When the perforated strip of paper used at the transmitting end is introduced with the last end of the message first the message received will not require to be rewound, and will be in position for use.

I am aware that mechanism has been employed for moving a panoramic web and winding the same upon one roller as it is unwound from another; but this is not adapted to a strip of telegraphic paper that is removable and drawn through only once.

I claim as my invention—

1. The combination, with the rollers *g h*, actuated by a train of gearing, of guides for a strip of telegraphic paper, and a table or rest contiguous to such strip, upon which the message is transcribed, as set forth.

2. The combination, with the rollers *g h* and the removable winding-roller *l*, of the guides for the strip of telegraphic paper, and the paper-roller *a*, substantially as set forth.

Signed by me this 11th day of February, A. D. 1875.

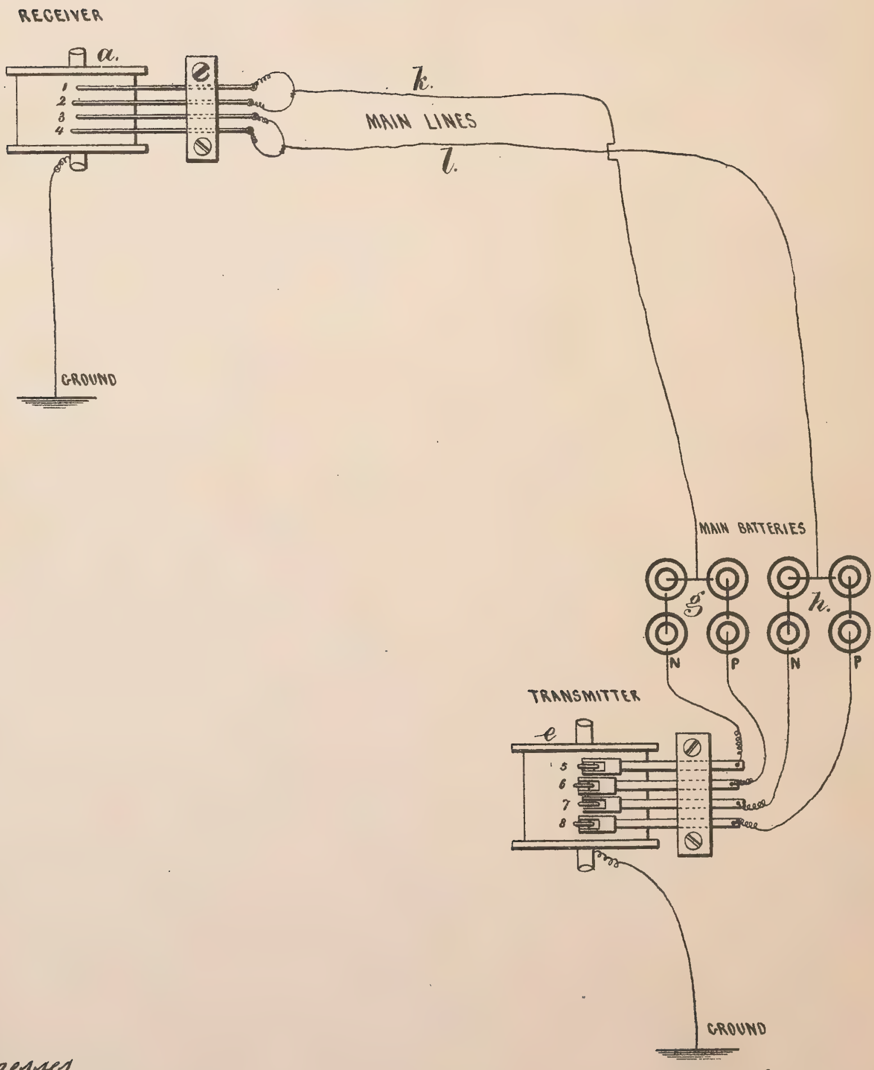
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

T. A. EDISON.

AUTOMATIC ROMAN-CHARACTER TELEGRAPH.

No. 172,305. Patented Jan. 18, 1876.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC ROMAN-CHARACTER TELEGRAPHS.

Specification forming part of Letters Patent No. **172,305**, dated January 18, 1876; application filed January 15, 1875.

No. 92.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

This improvement is available in transmitting block or Roman characters made by perforations in a strip of paper, such as shown in my Patent No. 151,209, and receiving the same upon a strip of chemically-prepared paper.

I make use of four transmitting-rollers and two line-wires, and I arrange the rollers to act in pairs, one slightly ahead of the other, and I arrange the circuits so as to send positive or negative currents, and employ points or styluses in pairs, one of which is iron, the other tellurium, the decomposition in the chemical paper with one metal taking place with the positive current, and with the other metal with a negative current; hence, although all four points are in contact with the chemical paper, only one on each line will be operative, according to the polarity of the current passing over that line.

In the diagram on the drawing, *a* represents the receiving-roller, over which the chemical paper is drawn, as usual. 1 2 3 4 are the stylus-points, 1 and 3 being of iron. 2 and 4 are slightly in advance of 1 and 3.

At the sending station the roller or drum *e* receives the paper, which is perforated with holes, indicating block-letters, as in said Patent No. 151,209, and the paper is drawn along upon the roller *e*, as usual, and it passes beneath the circuit-closing points or rollers 5 6 7 8, and the rollers 6 and 8 are in advance of the rollers 5 and 7. There are four rows of perforations in the paper to compose the letters, so that to each row there is a circuit-closer. There are two batteries, *g* and *h*, connected to the line-wires *k l*, each line-wire being connected to the middle of the battery, and ends *n* and *p* leading to the respective circuit-closers 5 6 and 7 8; the rollers or drums *a* and *e*, respectively, being connected to the earth, and the line-wires at the receiving end being connected, one to 1 and 2, and the other to 3 and 4.

The operation is, that when either 6 or 8 closes the circuit through the perforations in the paper, a positive current passes by the ground, and the return is through the line-wire, and the tellurium point 2 or 4 makes its mark, but the iron point does not make any mark; but when either 5 or 7 closes the circuit through the perforated paper the current passes over the line-wire, returning through the earth, and the iron point marks with this current, but the tellurium does not; hence, as the rollers that work with one line-wire are one in advance of the other sufficiently for currents of opposite polarity to be sent by perforations that are in line across the strip, the marks at the receiving-station will, in consequence of the movement of the paper, occupy their proper positions, and the aggregate result will be a letter corresponding to that produced by the perforations of the transmitting-strip.

If three line-wires are employed instead of two, there may be six rows of perforations made use of in the letters.

I claim as my invention—

The combination of two or more transmitting points or rollers, arranged one in advance of the other, and the connections to the batteries and line-wires, so as to transmit positive or negative currents by the perforated paper, with stylus-points of different metals, arranged one in advance of the other, so that one marks with a negative, and the other with a positive, current, substantially as set forth.

Signed by me this 7th day of August, A. D. 1874.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

AUTOMATIC-TELEGRAPHY.

No. 173,718. Patented Feb. 22, 1876.

Fig. 1.

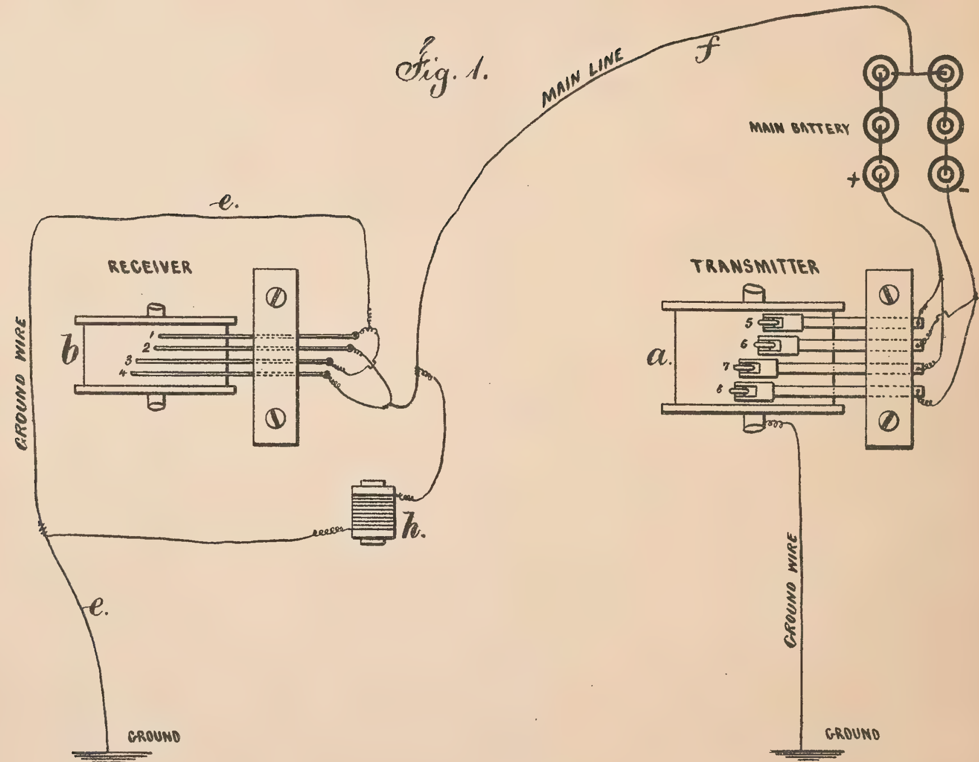


Fig. 2.

Witnesses,

Chas. H. Smith

Harold Serrell

Inventor.

Thomas A. Edison

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, D. C.

IMPROVEMENT IN AUTOMATIC TELEGRAPHY.

Specification forming part of Letters Patent No. **173,718**, dated February 22, 1876; application filed January 15, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to produce block characters on chemical paper by aggregation of dots, and the transmission is effected by a strip of perforated paper, the perforations being grouped together to form the block letter, as in my Patent No. 151,209.

I make use of four lines of perforations in composing the block letter, four rollers or stylus-points at both the receiving and transmitting stations. The first pair of rollers are in advance of the second pair, and one roller of one pair and another of the other pair are connected, and act with a positive current over the lines, and the other rollers of the other pair act with the negative current. This arrangement produces the record of the letters properly in succession in dots, forming block characters; but there are also produced some false dots between the letters, that are stopped-out or obliterated by hand at the receiving-station, so that only the true characters remain visible.

In the annexed diagram the receiving-drums *a* and *b*, at the transmitting and receiving station, respectively, are operated as usual, and draw along the strips of perforated paper *c* and chemical paper *d*.

The receiving stylus-points 1 and 3 are connected to the earth-wire *e*, and the stylus-points 2 and 4 are connected to the line *f*, and between the line *f* and ground-wire *e* a small electro-magnet, *h*, is placed, so as to act to neutralize the static or induced current in the line, as explained in my Patent No. 135,531.

At the transmitting-station the rollers 5 and 7 are connected to the positive pole of the battery *l*, and the rollers 6 and 8 to the negative pole, the line-wire *f* being connected to the center of the battery, and the drum *a* being connected to the earth.

Suppose, now, that four transverse perforations, composing the letter "I," pass under the rollers 5 6 7 8; the roller 5 first sends a negative pulsation through the ground through 1 and 3, marking the paper, returning by 2 and 4 to the line, and these points 1 and 3 will mark, but 2 and 4, being a negative return current, will not. No. 1 is a true mark, but 3 is a false mark, that is obliterated, as illustrated in Fig. 2. The roller 6 now sends a positive current over the line, which goes by 2 and 4, and leaves by 3 and 1. The mark 4 is false, and is obliterated. The pulsation sent by 7 is next negative, and goes by 1 and 3, and mark 3 is true, but 1 is false, and is obliterated, and then the roller 8 sends a positive current over the line by 2 and 4, returning by 1 and 3. The mark 4 is the true one, and 2 is the false one; but, in consequence of arranging the pairs of points in advance of each other, as shown, the false marks are brought together between the respective characters, while the characters themselves stand out true and correct.

The character will be made by the pulsations as indicated, according to the arrangement of the perforations representing that character, and the false marks, being between the character, are blotted out by a boy or attendant after the strip of paper is received from the machine, so as only to leave the characters themselves apparent between the blots, as illustrated in Fig. 2.

I claim as my invention—

Four transmitting stylus-points or rollers, connected in pairs to the positive and the negative of a battery, to which the line-wire is united at the center, in combination with two stylus-points connected to the line and two to the earth at the receiving-station, the parts being arranged and operated as set forth.

Signed by me this 7th day of August, 1874.

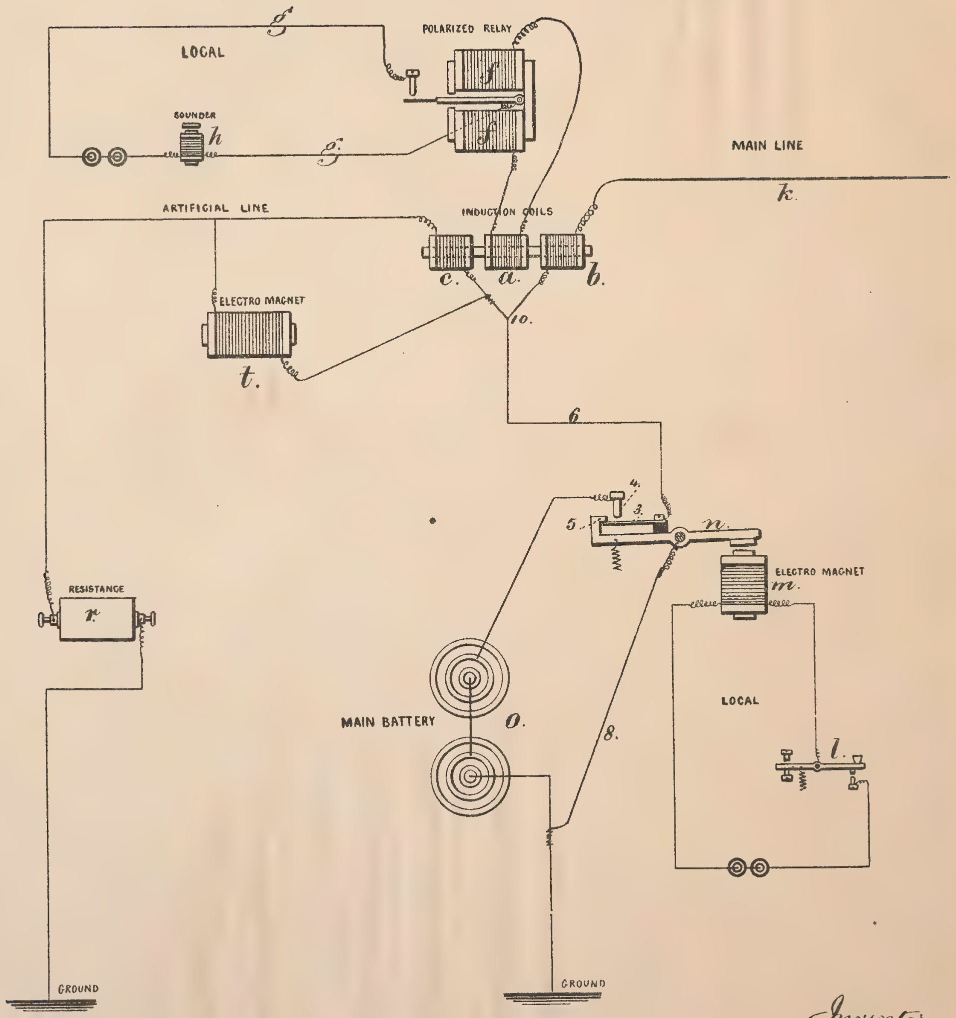
THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,221. Patented May 30, 1876.



Witnesses

Chas. H. Smith
Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,221**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

I make use of a compound induction-coil, through which the currents pass, and those from the sending-station are balanced, but the current from the distant station is operative.

The helix *a* surrounds the central part of the core that passes through the electro-magnets *b* and *c;* hence a secondary or induced current is set up in the helix *a* only when there is an excess of current in one of the helices *b* or *c*, because if the current acting in *b* is equal to that acting in *c*, and the helices are properly wound, the magnetizing actions of the helices on the core will neutralize each other, and there will not be any secondary or induced current in *a;* but when the current in one helix is greater than that in the other, the core will be magnetized, and a secondary current set up in the helix *a*.

I avail of this feature of the compound differential induction-coil to operate a duplex-telegraph instrument, by causing the current at the sending-station, where this compound differential instrument is placed, to divide and act equally in both *b* and *c;* but when the current from the distant station increases the energy of the helix *b*, then the induction or secondary current set up in the helix *a* magnetizes the core sufficiently to set up a current in *a*.

The current in *a* operates in the polarized magnet *f* to open and close the local circuit *g*, in which is placed the receiving or sounder instrument *h*.

When the pulsation passing along the line *k* from the distant station ceases, the core of the helix *b* demagnetizes, and in so doing sets up a second induced current in *a* of opposite polarity to the first, and that acting in the polarized magnet *f* instantly throws the contact-point of the armature the other way and opens the local circuit.

These operations in the compound differential induction-coil being borne in mind, it now becomes necessary to explain the manner of sending through such coils without producing any action on the helix *a*.

The key *l* in the local circuit to the magnet *m* operates the lever *n*, that contains an insulated spring-closer, 3, acting against the circuit-point 4, and the hook end 5 of the lever *n*, so that when the key *l* is closed, the lever *n* moves the spring 3 into contact with 4, closing the circuit from the battery *o*, through 4 3 and the wire 6, to the helices *b* and *c*, and at the same time breaking the contact of 3 and 5, and hence cutting out the ground-wire 8 from the lever *n;* but the moment the lever *n* returns to its normal position by the demagnetizing of *m*, the spring 3 closes the circuit at 5, just before separating from 4; hence there is always a metallic circuit complete for the pulsation coming from the distant station, whether the circuit of the sending-battery *o* is opened or closed.

In order to balance the action of the sending-current, that divides at 10, and passes through *b* and *c*, I introduce, in connection with the helix *c*, an artificial line equal in resistance and conditions to the line *k*, hence compelling an equal current to pass through *b* and *c*. To effect this the resistance *r* is placed in the ground-connection from *c*, which resistance should be adjustable, so that the rheostat or resistance *r* equals the line; and in order to set up in *c* a counter magnetism equal to that set up in *b* by the static from the line, I make use of the electro-magnet *t*, placed in a shunt that passes around *c*.

By this construction of compound differential induction-coil, and the arrangement of the connections, the inductive effects of pulsations from the sending-instrument are balanced and neutralized, while the pulsations from the distant station operate the receiving-instrument.

I claim as my invention—

1. The compound differential induction-coils *a b c*, in combination with the polarized relay *f* and the circuit-connections, substantially as set forth.

2. The artificial line, composed of the rheostat *r* and magnet *t* and ground-connection, in combination with the compound induction-coil and line-connections, substantially as set forth.

Signed by me this 19th day of August, 1874.

THOS. A. EDISON.

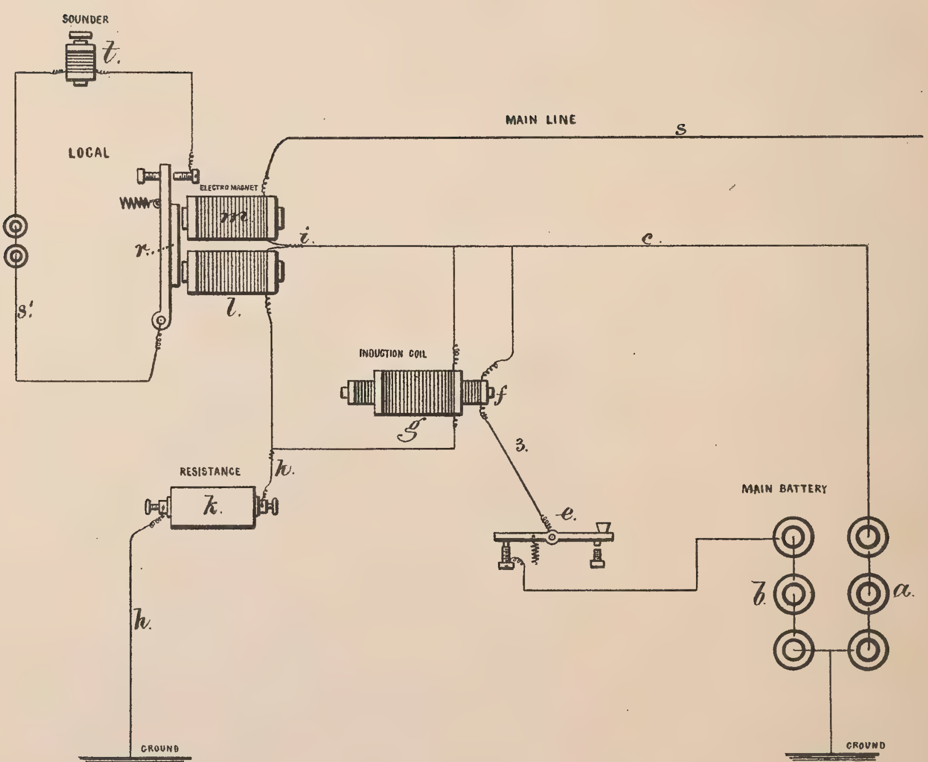
Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,222. Patented May 30, 1876.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

atty.

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,222**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

A balanced battery is used for transmitting when the balance is disturbed. An electro-magnet is used, through which both the received and transmitted pulsations pass, and the connections are made so that the action of the current sent is balanced, while that coming from the distant station is operative, to work a balanced relay and local circuit or sounder.

In the accompanying diagram drawing, the battery *a b* is connected at an end to the line-wire *c*, at the other end to the closed key *e*, and in the middle to the ground. The connection 3, from the key *e* to the line *c*, passes through the induction-coil and core *f*, and there is a second induction-coil, *g*, around the coil *f*, that is in a shunt between the line-connection *c* and the branch *h* to the ground, in which branch *h* there is a resistance, *k*, that is adjustable.

The line-connection *c* bifurcates at *i*, passing one way through the helix *l* to the ground-branch *h*, and the other way through the helix *m* to the main line *s*. The electro-magnet *l m*, being wound in the usual way, will not respond when the connection is made in the middle, because the current passing from *c* goes one way through one helix, and the other way through the other, polarizing the cores, so that the armature *r* is not attracted.

It is important that the resistance of the branch *h* and rheostat *k* should be about the same as that of the main line *s*, so as to cause the current to divide equally at *i*.

It will now be understood that any current from the distant station passing through the magnet *m*, in the usual direction, will cause the armature to respond, whether there is any current passing through the helices or not from the sending-station, and this electro-magnet *m* and armature act as a relay to operate the local circuit *s'* and sounder *t*.

The main battery, it will be seen, is in a local circuit when the key *e* is closed; hence, if both sides are equal, there is no current passing upon the main line; but when the key *e* is open the local circuit is broken, and the portion *a* of the battery sends the pulsation through *l* and *m*, and upon the line *s*, to the distant station, where the pulsation passing through *m* operates the local and sounder or receiver, the portion through *l* returning to *a* through the branch *h* and ground.

When the key *e* is closed the induction-coil *f* is charged, and it discharges when the key *e* is opened. The helix *g*, that has been charged by induction, also discharges, and sets up in *l* a current that equals that resulting from the static charge of the line, and the reverse currents are produced in the induction-coils as the circuit is closed at *e*. Thus such induction-coils serve to neutralize or balance the effect of the static charge, and prevent any false pulsation on the main line resulting from the return static charge acting in *m*.

It will be apparent that the closing of the key *e* and the connecting of the battery *b* with the line tends to set up in the line and to earth currents of opposite polarity to those resulting from the battery *a*, because the positive of the one and the negative of the other are to the ground and line, respectively, and this local circuit (*c a* 3 *e b*) serves to maintain an unbroken connection, that offers but little resistance to the pulsation from the distant instrument passing to the earth, and the resistance is nearly uniform to the current received, whether there is a current that is being sent or not.

I claim as my invention—

The battery *a b* in a local circuit, connected to the line, in which is a circuit-breaker, a finger-key, in combination with the magnet *l m*, branch *h*, and resistance *k*, and the induction-coils *f g*, the parts operating substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

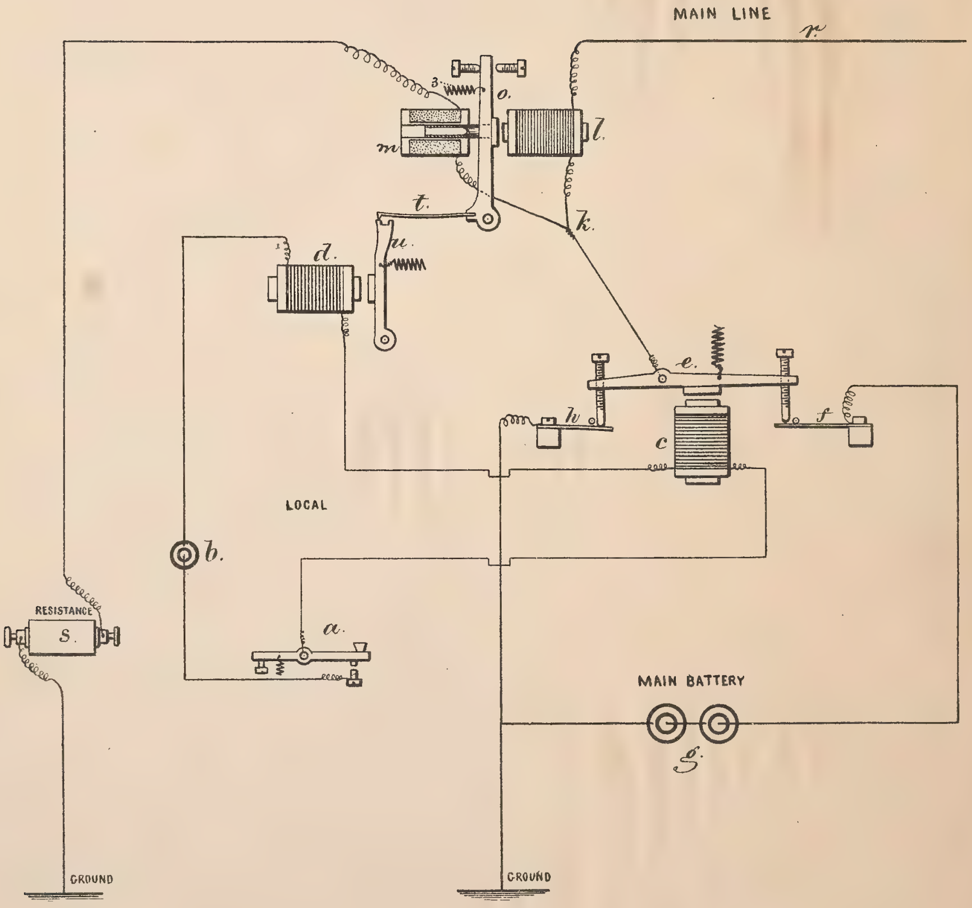
THOS. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 178,223. Patented May 30, 1876.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **178,223**, dated May 30, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, Essex county, New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

The transmitting-battery is connected with the line by a lever that simultaneously breaks the earth-connection, so as not to interrupt the continuity of the circuit. The current sent divides and operates equally in two helices. In one helix there is a sliding core that moves with the armature of the other helix, and this latter responds to the pulsation from the distant instrument and closes a local circuit to a sounder or other receiving instrument, and there is a mechanical device that serves to compensate the attraction in one of the magnets that is due to the reverse action of the static discharge, thereby causing the forces to be accurately balanced.

In the diagram of the drawing, the transmitting-key *a* opens and closes the local circuit of battery *b* to the helices of the electromagnets *c* and *d*.

The lever *e*, actuated by the armature of *c*, closes the line-connection *f* from the battery *g* just before breaking the earth-circuit of the line at *h*, so that there is always a path for the pulsation from the distant station.

The circuit from *e* bifurcates at *k*, and a portion of the pulsation sent passes through *l* and upon the line *r*, and an equal portion of the pulsation passes through *m* to the artificial line composed of the rheostat *s* and ground-connection, said rheostat being adjusted to equal the resistance of the line.

The armature-lever *o* is inoperative by the current sent, because the action of the two magnets on the same is balanced, the attractive forces of such magnets being equal; and I make the core of the magnet *m* to slide in the helix, and attach it to the armature-lever *o*, so that the cores of *l* and *m* may be equally energized, and not influenced by the current sent, whether the armature is near the core of *l* or drawn back therefrom by the spring 3.

It will now be understood that the lever *o* will not respond when the pulsation sent passes through *l m*, but that the armature-lever *o* will respond to the pulsation from the distant station, because the same only acts in *l*, and by this lever *o* a local circuit and sounder or other receiver is operated.

The pulsation sent from *g* upon the line *r* is increased by the static charge, and upon cessation of the pulsation the static charge reacts and these operations might disturb the balance between *l* and *m*. I therefore employ the mechanical compensator formed of the spring *t* and notched armature-lever *u*, to the magnet *d*; hence, when the current is closed at *a*, and the armatures of *e* and *u* are attracted, the motion of the lever *u* brings the notch at the end of such lever across beneath the V-projection on the spring *t*. Thereby the force of the spring *t* is relieved, and then again bent, and when relieved the spring 3 exerts its full power. And when the spring *t* is bent, its force lessens the power of the spring 3; hence this spring 3 is able to resist the increase of magnetism due to the static condition of the line when the circuit is closed, and to compensate for the reaction of the static charge as the circuit at *a* is broken, thus leaving the magnet *l* entirely uninfluenced by the current sent, and capable of the most delicate adjustment by the spring 3 for receiving from the distant station.

It is to be understood that the effect of the static electricity is apparent when the magnet *l* is charged and discharged, and that at that moment the notch in the end of *u* relieves the end of the spring *t*, allowing the increased power of the spring 3 to compensate for the static electricity acting in the magnet *l*.

I claim as my invention—

1. The magnets *l m*, through which the current sent passes to the line, and artificial line, in combination with the armature-lever *o*, and sliding core, substantially as specified.

2. The electro-magnets c d, in the local circuit containing the circuit-breaker a, in combination with the circuit-closing lever e, notched armature lever u, spring t, and armature-lever o, substantially as set forth.

3. The mechanical compensator, consisting of the spring t and notched lever u, for neutralizing the effect of the static charge in a duplex telegraph, substantially as se forth.

Signed by me this 19th day of August, A D. 1874.

THOS. A. EDISON.

Witnesses:

CHAS. H. SMITH,

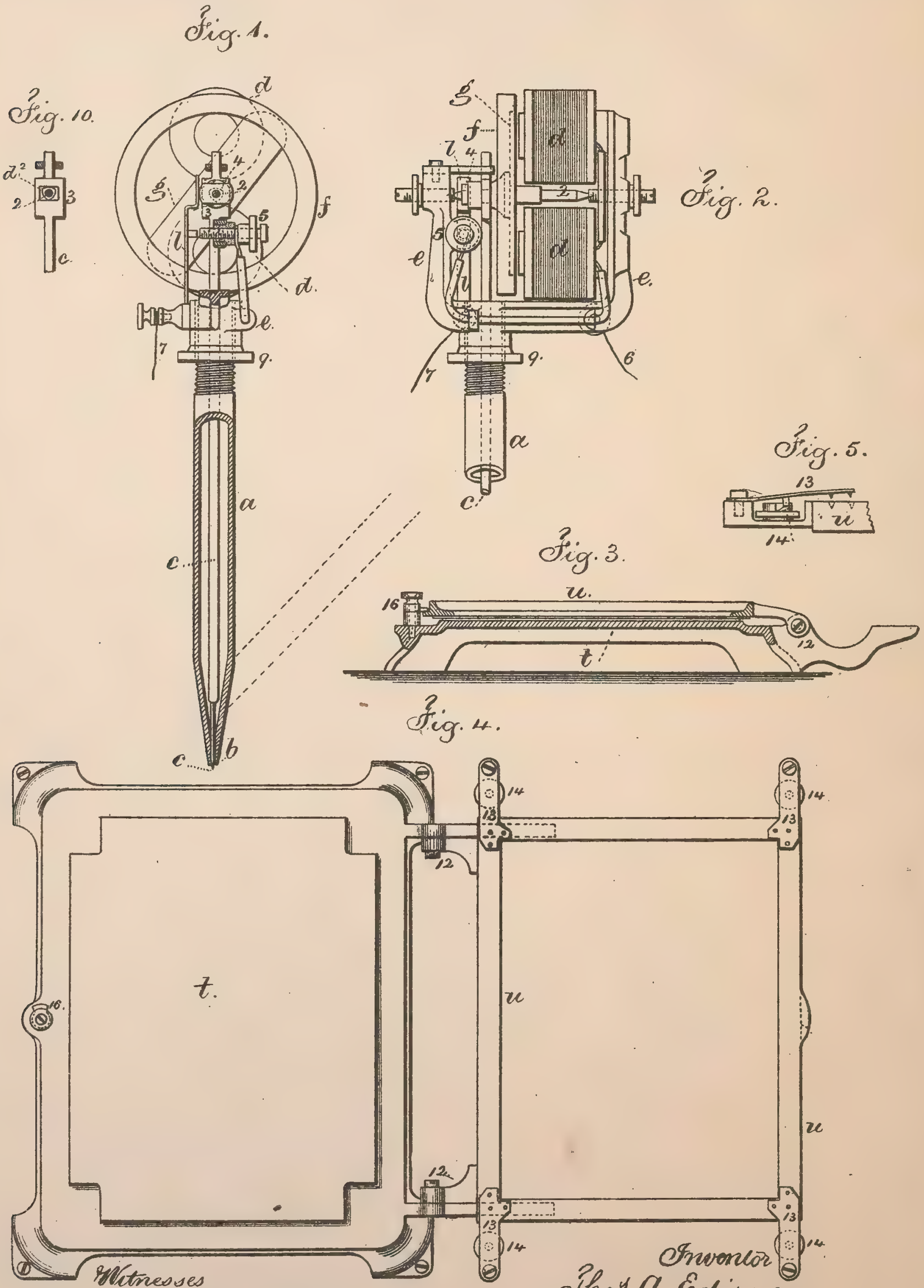
GEO. T. PINCKNEY.

2 Sheets—Sheet 1.

T. A. EDISON.

AUTOGRAPHIC PRINTING.

No. 180,857. Patented Aug. 8, 1876.



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
per Lemuel W. Serrell atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.

AUTOGRAPHIC PRINTING.

No. 180,857. Patented Aug. 8, 1876.

Fig. 8.

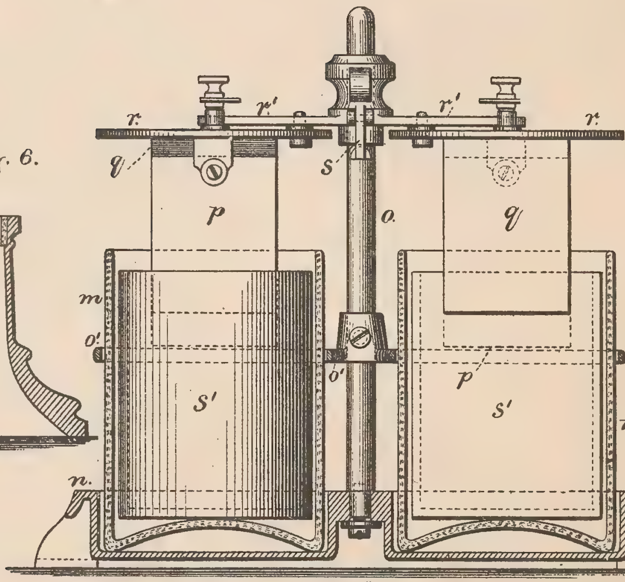


Fig. 9.

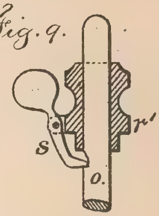


Fig. 6.

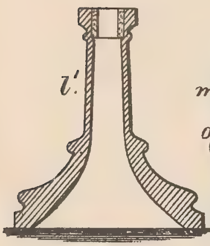
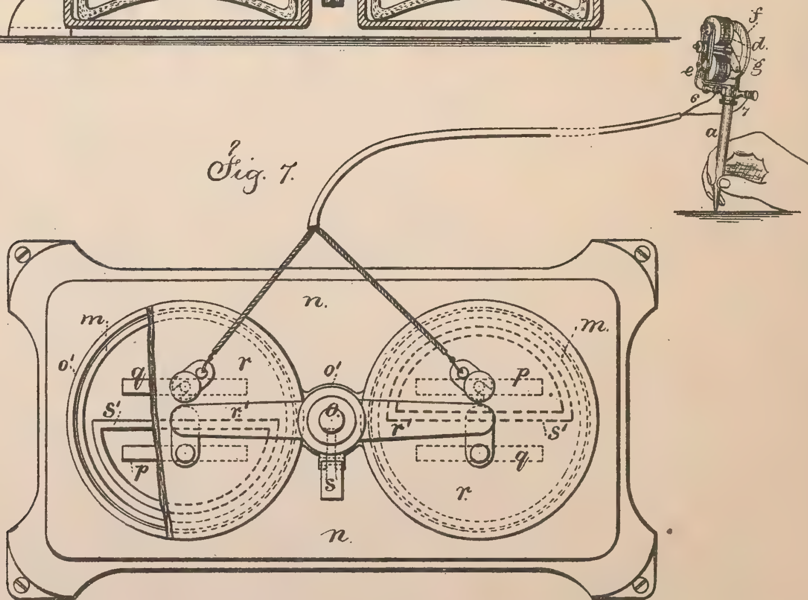


Fig. 7.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thos. A. Edison,
per Lemuel W. Serrell
Att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN AUTOGRAPHIC PRINTING.

Specification forming part of Letters Patent No. **180,857**, dated August 8, 1876; application filed March 13, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Autographic Printing, of which the following is a specification:

Patterns for embroidery and for fresco painters have been made of paper, perforated with numerous holes in the lines to be transferred, and the transfer has been done by a fine colored powder, dusted over and rubbed into such holes while the article is upon the surface that receives such transfer. This is not adapted to writing, because the color employed is not permanent, and no means has been devised that could easily be made use of in writing or drawing by hand with rapidity that rendered the operation practically available for autographic printing.

My improvement relates, first, to the instrument employed for puncturing the paper, whereby such instrument can be used by hand in the same manner as a drawing or writing pen; second, to the method of printing by direct transfer in permanent semi-liquid ink from the perforated sheet; and third, to the press for holding such transfer-sheet, and the paper to be impressed.

In the drawing, Figure 1 is a vertical section of the pen or stylus, in a form that I have discovered to be very convenient in use. Fig. 2 is a side view of the actuating-magnets. Fig. 3 is a section of the press. Fig. 4 is a plan of the same, as open. Fig. 5 is a section of the paper-holding clamp. Fig. 6 is a section of the pen-holding stand in smaller size than the pen Fig. 1. Fig. 7 is a plan of the battery, illustrating, also, the flexible connection to the distant pen as in use. Fig. 8 is an elevation of the battery, partially in section; and Fig. 9 is a section of the pole-supporting catch of the battery.

The pen which I make use of consists of a tube, *a*, tapering to a small point, *b*, and a needle, *c*, within that tube, which needle is reciprocated with great rapidity; and when the needle-point *c* is projected it is sufficiently long to reach through the paper upon which the tube of the pen rests, and when retracted the needle is drawn within the tube, so that the small end thereof is free to be moved from place to place. The great rapidity in the movement of the needle-point produces the punctures in the paper sufficiently close together to form lines when the pen is manipulated in writing or drawing; and, as nothing is removed from the paper, its strength is not materially injured by the punctures or perforations; and it will be apparent that any suitable device may be employed for reciprocating the perforating-needle; and as I have invented numerous devices for which I contemplate applying for Letters Patent hereafter, I have only shown herein the device which I prefer to use, viz: an electro-magnet and revolving-armature fly-wheel.

The electro-magnet *d* is upon the frame *e* that supports the axis 2 of the fly-wheel *f*, and this fly-wheel is connected with the armature *g*. Upon the axis 2 there is an eccentric or a cam, with one or more arms acting upon the stock 3 at the upper end of the needle-bar. It is preferable to employ a three-pointed cam, d^2, as seen in Fig. 10, upon the axis 2, so as to give three up-and-down motions to the needle-point each revolution of the axis 2.

The commutator or circuit-closer to the electro-magnets is composed of the spring *l*, acted upon by the notched or flattened disk 4 to open and close the circuit through the screw 5, and thus actuate the electro-magnetic motor in the usual manner.

The wires 6 and 7 lead to the battery shown in Figs. 7 and 8, in which the glass cells *m* are in a metal stand, *n*, held by the standard *o* and ring *o'*. The carbon-pole *p* and zinc-pole *q* are connected with the cover *r* and cross-bar *r'*, that are fitted to be raised or lowered upon the standard *o*, and when raised out of use, as in Fig. 8, the parts are held up by the latch *s* passing into a notch in the standard *o*, as in Figs. 8 and 9. The porous cups *s'* in the cells *m* are nearly half-cylinders, as shown. This construction of battery is very convenient for this autographic pen, because it occupies but little space and is easily transported and brought into or put out of action. The liquids preferably employed in the battery are bichromate of potash and sulphuric acid.

The tube of the pen screws into the frame *e*, and it is provided with a set-nut, 9, by means of which it can be clamped after the tube has

been adjusted, so as to allow the needle to be drawn into the tube and projected by the motor as aforesaid.

A stand, l', Fig. 6, is provided with a hole at the upper end, of a size to receive the tube of the pen and support the same, and protect the point from injury when entered within such stand. The conductor from the pen to the battery must be flexible, so as to allow the pen to be easily moved about in performing the writing.

The mode of printing from the perforated sheet is to fill the holes with ink by means of a roller applied to the right side of the perforated sheet; and then when said ink is well worked into the holes to place beneath such perforated sheet the paper upon which the impression is to be made, and then pass over the perforated sheet a roller that presses the ink through the perforations to the surface of the sheet below.

As a convenient means for doing this printing, I make use of the bed *t*, to which the frame *u* is hinged at 12, and at the corners of this frame *u* are the spring-plates 13, with holding-points; and these spring-plates are raised from the surface of the frame by turning the cam-buttons 14, so that the perforated sheet can be placed between the frame and these clamping-springs; and then the cam-buttons 14, being turned the other way, allow the springs to catch and firmly hold the corners of the perforated sheet. A sheet of paper is now laid down upon the bed *t*, the frame *u* turned over upon it and secured by the clamping-button 16 being turned over the edge of this frame *u*. A roller, covered with felt or other similar material, and having ink upon its surface, is now rolled over the perforated sheet until all the holes are filled and an impression made by the ink through such holes upon the surface of the sheet below. The hinged frame holding the perforated sheet may be lifted for inspecting the impression, and closed down again if the impression is defective at any part. After the holes are filled the impressions upon other sheets can be made in succession very rapidly, and a small quantity of ink is added from time to time.

Printer's ink, thinned out with castor-oil, may be employed, or aniline colors may be used, mixed with glycerine and molasses.

Various forms of electro-magnetic motors may be employed to revolve the shaft that reciprocates the puncturing-needle, and the movement of a vibrating armature might be transferred directly to the needle, if desired.

It is generally preferable to have the perforating-needle perpendicular to the paper; and, for convenience in holding the same, there may be a handle connected with the pen-tube *a*, and occupying an inclined position, as indicated by the dotted lines, Fig. 1.

I claim as of my invention—

1. The portable perforating instrument for writing or drawing, composed of a tapering tubular stock, adapted to be held and moved by hand, and provided with a perforating-needle and its reciprocating mechanism, substantially as specified.

2. The method herein specified of printing in permanent semi-fluid ink by puncturing a sheet of paper, or similar material, with numerous small holes, filling such holes with a semi-liquid ink, and pressing the same upon the surface to be printed, substantially as set forth.

3. The swinging frame *u* and paper-holding clamps 13, in combination with the bed *t*, for receiving and holding the sheet of perforated paper, and the sheet to be printed, substantially as set forth.

4. The combination with the revolving magnetic motor, pen-holder *a*, and puncturing-needle *c*, of the cam d^2, having three or more points, substantially as set forth.

5. The combination, with the portable hand-perforating instrument having an electro-magnetic motor, of a flexible conductor and a battery, substantially as set forth.

6. The portable galvanic battery composed of cells in a stand, with a pole-supporting rod, latch, and cross-head, in combination with flexible conductors, a magnetic motor, and a perforating-pen, substantially as set forth.

Signed by me this 7th day of March, A. D. 1876.

THOS. A. EDISON.

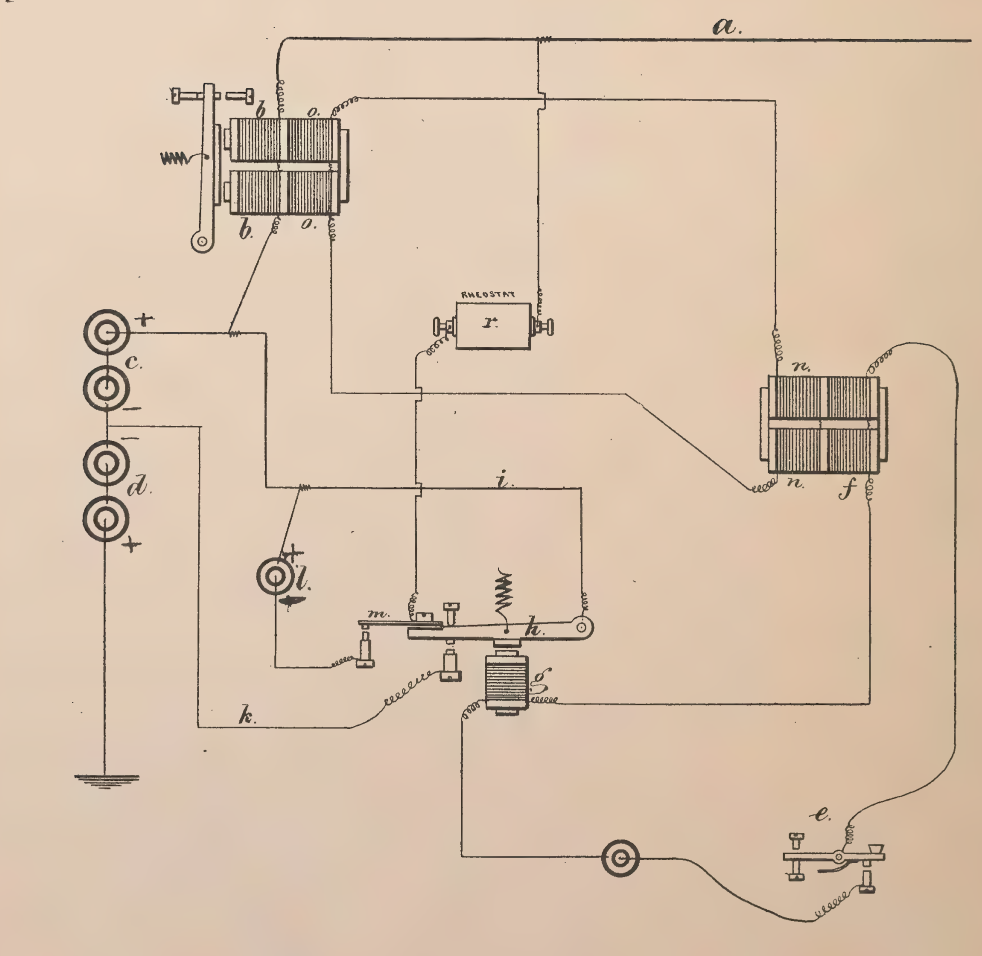
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

DUPLEX TELEGRAPH.

No. 180,858. Patented Aug. 8, 1876.



Witnesses

Chas. H. Smith
Harold Serrell

Inventor

Thomas A. Edison
per L. W. Serrell
atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **180,858**, dated August 8, 1876; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

The main battery is in two parts connected in reverse in the line-circuit. In the same circuit is the receiving instrument or relay, to which is connected a local circuit and sounder. One-half of the battery is short-circuited at the sending-station by the depression of the key. Simultaneously with this depression a local circuit is closed and a reverse current sent from a battery through the receiving-magnet, and in that circuit is a rheostat that is adjusted so that the effect of the battery on the line is neutralized in the receiving-relay at the sending end; but the battery at this distant end is free to act at the receiving-station. At the same time the effects from the static charge in the line are neutralized in the receiving-instrument by induction.

In the diagram, *a* is the line passing through the electro-magnet *b* that operates a relay or sounder. The connection from *b* is through the batteries *c d*, or local circuit *i l k*, to the earth. The batteries *c* and *d* oppose each other, and, being equal, are not operative in *b*. The key *e* is in a local circuit, in which are the helices *f g*, and when the key is closed the electro-magnet *g* attracts the armature and lever *h*, closing the circuit *i k* to the center of the batteries *c d*, hence short-circuiting *c*, and allowing *d* to act in the line. In order to compensate the action of the battery *d* in *b*, the local battery *l* is used, and the local circuit from *l*, through the insulated spring *m* and rheostat to the line *a*, is closed simultaneously with the short-circuiting of *c*, and this rheostat *r* is adjusted so that the action of *l* in *b* equals the action of *d* in *b*, and, being in reverse, the forces are neutralized. The helices *f* and *g* being charged and discharged simultaneously, there is an inductive current set up in the core of *f* and the helix *n*, and that gives a secondary charge to the helix *o* that surrounds the core of *b*, and hence when *e* is closed the secondary effect in *n* neutralizes the static effect as the line is charged, and, as the circuit at the key *e* is broken, a reverse induction-current is set up in *n*, neutralizing the discharge of the static charge of the line, the helices being wound so as to produce this reverse and neutralizing effect in the core of the electro-magnet *b* of the helix *n*.

I claim as my invention—

1. The local equating-battery *l*, and rheostat *r*, connected to the line *a*, and to the receiving-magnet *b*, in combination with the batteries *c d*, shunt *i*, and lever *h*, substantially as and for the purposes set forth.

2. The magnets *g* and *f*, and induction-coils *n o*, in combination with the magnet *b*, batteries *c d*, and shunt-circuits, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

THOS. A. EDISON.

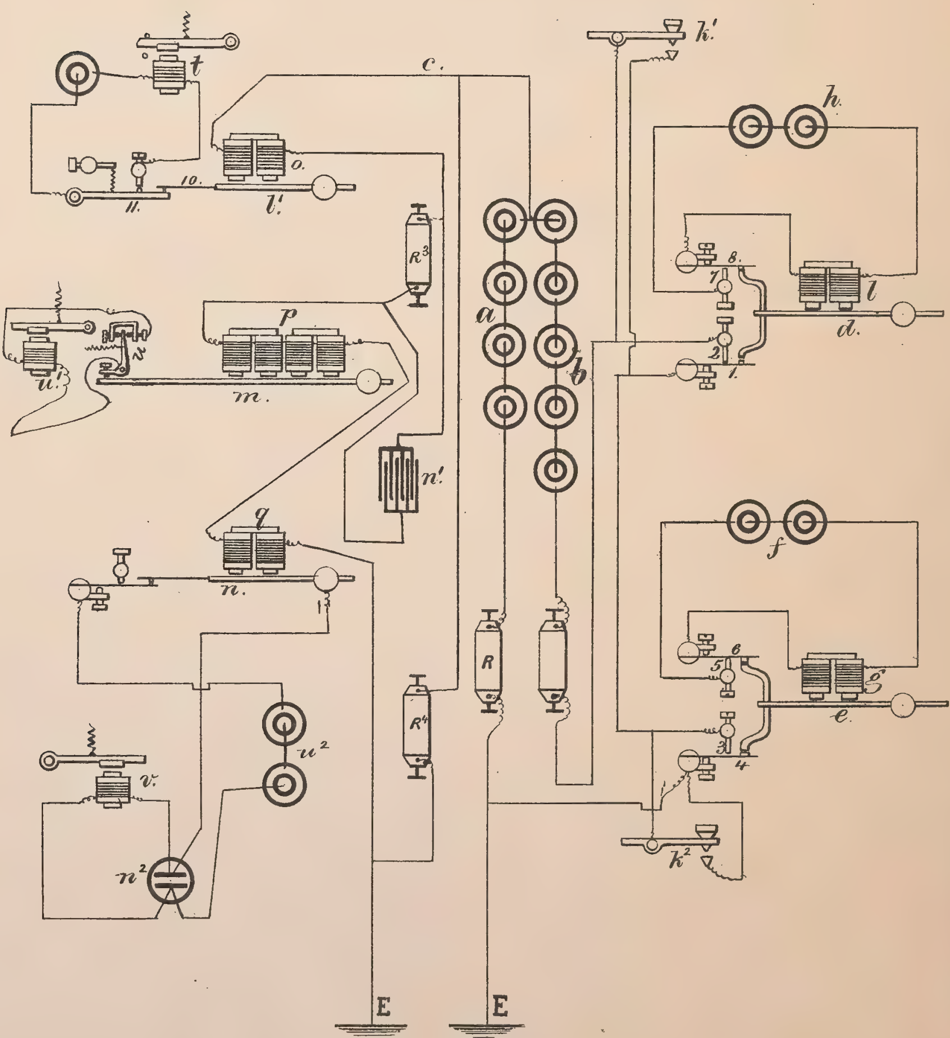
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

ACOUSTIC TELEGRAPH.

No. 182,996. Patented Oct. 10, 1876.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell

Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC TELEGRAPHS.

Specification forming part of Letters Patent No. **182,996**, dated October 10, 1876; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

Two batteries are connected to the line and to the earth, and the earth-connection from one is direct, and in the earth-connection from the other are the tremolo circuit-closers of the reeds, and also finger-keys. When one tremolo is short-circuited by its key, the other tremolo only is operative in sending pulsations over the line, and the distant reed responds to the same. When both are operative in sending pulsations, both receiving-reeds at the other end respond. One battery is slightly stronger than the other, and when the short circuit of the stronger battery is broken the other battery is operative upon the line, and when the other circuit is closed to the earth the weaker battery is overpowered and a weak pulsation sent upon the line, clearing it of its static charge. In this manner the pulsations from the tremolo circuit-closers can be very rapid, and, the batteries being connected with opposite poles to the line, the static effects are neutralized by the transmission of a slight contrary current, due to the excess of one battery over the other.

The battery is made of the minor element *a*, and major element *b*, with zinc of *a*, and copper of *b*, to line. The battery *a* is connected to earth E through rheostat R, and from the battery *b* to earth there is a circuit-wire, in which are the tremolo circuit-closers 1 2 and 3 4. The key k^1 short-circuits the tremolo 1 2, and the key k^2 short-circuits 3 4. The reeds or other vibrating bodies *d e* are operated and kept in vibration by the local circuits and electro-magnets, the battery *h*, magnet *l*, and circuit-closers 7 8 acting with the reed *d*, and the battery *f*, magnet *g*, and circuit-closers 5 and 6 acting with the reed *e*.

The operations of the transmitting portion of the instrument will be apparent. The reeds *d* and *e* being constantly vibrated, and vibrating at different rates of speed, as in other acoustic telegraphs, the circuits at 1 2 and 3 4 will be opened and closed in harmony with the respective reeds, and the pulsations will pass over the line from the battery *a* whenever the circuit of battery *b* is broken, the power of battery *a* being free to act and pass over the line; but when the circuit of *b* is closed an excess of current passes from the battery *b* into the line, to neutralize static effect and clear the line. When either key k^1 or k^2 is closed, the corresponding tremolo circuit-closer becomes inoperative on the line because of the continuous metallic connection short-circuiting the same. The other tremolo circuit-closer, however, may be fully operative. By this means the cessation of vibration of the receiving-reed, or its equivalent, corresponds with the circuit-closing of the finger-key at the sending station, and the vibration denotes a state of rest of the finger-key. If the normal condition of the finger-key was a closed circuit through it, then the signal would result from the vibration of the reed at the receiving-station corresponding to the opening of the finger-key circuit.

At the receiving-station the line *c* divides, and one branch passes by the rheostat R^4 to earth. The other passes through electro-magnets *o p q* to earth, and adjacent to these magnets are the vibrating reed-armatures toned to respond to the reeds of similar notes at the sending-station. There is a rheostat, R^3, that is shunted by the condenser n', the object being to avail of the discharge of the condenser to neutralize the static charge of the line. The rheostats are to be of proper resistance to effect this object. It is preferable to employ four spools, or a double electro-magnet at *p*, to operate upon the reed *m*, which is advantageous upon reeds of a high note, as they require more power than those of a low note to vibrate them. The poles of the electro-magnets are preferably arranged so that the two north poles come next each other, or the reverse, so that the inductive effects upon the reed will be neutralized, and tendency to stick avoided. The reed l' is prolonged in the form of a very light strip of metal, 10, that is, by preference, corrugated, to render it stiff. By this means a greater range of motion is obtained to operate the circuit-closer 11 of the local circuit and sounder *t*.

The reed m operates at the end against the short end of a lever, u, which may be a bent lever, so that the long end has greater range of motion and operates more reliably as a circuit-closer for the sounder u^1 in a local circuit than the reed itself. This lever u is positioned so that it is only operated by the reed m, when in full vibration; hence the local circuit-closer will not act when the magnet p ceases to operate upon the reed. The reed n opens and closes a local circuit passing through itself from the local battery u^2, and there is a secondary battery or acidulated cup, n^2, in the same circuit. The rapid vibrations of the reed n induce a constant magnetism in the sounder v in consequence of the secondary battery prolonging the current and preventing magnet v discharging until the reed n pauses in its vibration; hence the sounder or receiving-instrument v will be demagnetized and respond to the closing of the distant finger-key.

If the sending-instruments are placed at an intermediate station, the batteries a b may be in branches or derived circuits in the main line.

I claim as my invention—

1. In an acoustic telegraph, two sections, a b, of the battery, in derived circuits from the main line, in combination with resistances and a tremolo circuit-closer operated by the reed, or its equivalent, and placed in one of the battery-circuits, substantially as set forth.

2. In an acoustic telegraph, a battery, in two sections, connected to the line, and to derived circuits, in combination with tremolo circuit-closers, reeds operated by magnets, and keys to short-circuit the circuit-closers, substantially as set forth.

3. The combination, with an acoustic telegraphic reed, of an extension that is lighter than the reed, to operate circuit-closing devices, substantially as set forth.

4. The combination, with an acoustic receiving-instrument, of a derived circuit from the main line containing a condenser, and a resistance in the main line. substantially as set forth.

5. The combination, with a vibrating reed in an acoustic telegraph, of four electro-magnet spools placed in the main line, substantially as set forth.

6. The combination, with the vibrating reed m, of the lever u, and local circuit, arranged so that the lever u is only acted upon by the reed m when in full vibration. substantially as set forth.

7. The combination, with an acoustic telegraph, of a local circuit, a secondary battery, a receiving-instrument or sounder, and a circuit-closer operated by the reed, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

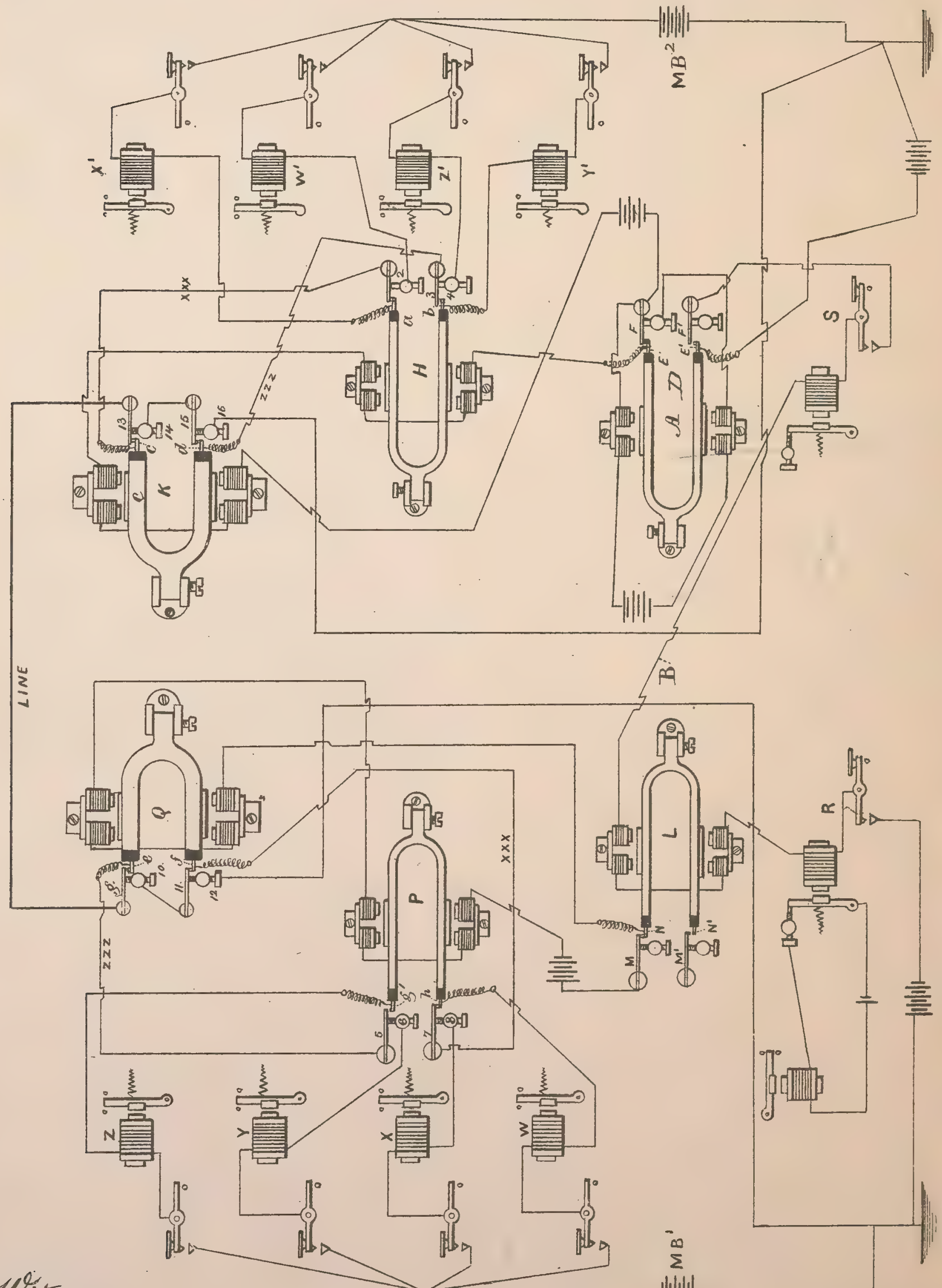
THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

T. A. EDISON.

ELECTRO-HARMONIC MULTIPLEX TELEGRAPH.

No. 185,507. Patented Dec. 19, 1876.



Witnesses
[illegible]
H. M. Haigh.

Inventor
Thos. A. Edison
per [illegible] Att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ELECTRO-HARMONIC MULTIPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **185,507**, dated December 19, 1876; application filed August 31, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to subdivide a single telegraphic circuit into a number of independent signaling-circuits, each of which may be operated by means of the signaling apparatus in ordinary use, and signals transmitted upon each signaling-circuit without interfering with the others, and in either direction at pleasure.

The invention consists, first, in a method and combination of apparatus for transferring a telegraphic line or circuit at two or more stations, either terminal or intermediate, successively from one set of signaling-instruments to several other sets of signaling-instruments, by the use of tuning forks or reeds at each station, kept in continuous vibration, by electro-magnets, with such rapidity and in such a manner that the brief time during which the circuit is disconnected from any one pair of signaling-instruments and returned thereto is not sufficient to interfere with the proper transmission of signals.

Second, the invention further consists in placing in the same circuit two tuning-forks or equivalent devices, one of which, in respect to the number of its vibrations in a given time, is a submultiple of the other, so that the high forks shall subdivide the wire into two signaling-circuits, which latter, being connected to the low fork, are thereby again subdivided into four signaling-circuits.

Third, the invention further consists in the method and combination of apparatus employed to control and regulate the transferring forks or reeds by means of the other tuning-forks, reeds, or moving bodies following the law of the pendulum, which are actuated by electro-magnets placed in a second circuit, and arranged to close at each vibration the local circuit, by which the transfer-forks are kept in vibration.

Fourth, the invention further consists in a method and combination of devices whereby the transferred circuit is momentarily connected to the earth during its passage from one set of signaling-instruments to another.

Fifth, the invention further consists in the combination of transfer-reeds, together with their signaling-instruments, local circuit, and batteries, with the main-line reed or reeds, by which means the accurate transfer of the main circuit upon the several instruments is effected.

Sixth, the invention further consists in the combination of signaling-instruments with the auxiliary or controlling circuit, in such a manner that it may be utilized for the transmission of signals, as well as for controlling the apparatus attached to the other line.

Seventh, the invention further consists in the placing of several sets of electro-magnetic transfer forks or reeds in the same local circuit at each of the different stations, whereby they are maintained in harmonious vibration with each other at all times.

I will now describe the various devices. A is the fundamental fork, which may either be in the main circuit of the controlling-line B, or in a local circuit. I have shown it in the latter. The fork makes, say, thirty-six vibrations in each second. (I do not confine myself to thirty-six, as twelve to five hundred will answer.) D is the contact devices, whereby the circuit in which the actuating-magnets are placed is opened and closed at each vibration, thus causing the reed to vibrate continuously. Upon the extreme ends of the prongs are insulated contact-points E and E′, which come in contact with springs F and F′. The contact of E and F serves to close and open the local circuit, in which the transfer-reeds H and K are placed, while the contact of E′ and F′ serves to close and open the controlling-circuit. This sets the fork L in motion, which, in its turn, by means of M and N, closes and opens the local circuit in which the forks P and Q, are setting them in motion. Now, if the contact time of the various springs and points upon the controlling-forks A and L is the same, the forks H, K, P, and Q will vibrate exactly in unison, and continue to do so, although a great variation may take place on the controlling-wire, in which A and L are placed. R and S are two signaling-instru-

ments, which are ordinary Morse apparatus, with the exception of the relays and keys having back points, the signaling-sounder closing when the circuit is opened by depressing the keys.

I will mention that signaling may take place at the same time that the fork L is working without interruption to it, as it requires from fifteen to twenty-five seconds after the controlling-wire is opened before its vibration becomes insufficient to open and close the circuit of the forks P and Q, and as a Morse signal only requires a fraction of a second, these slight openings do not interfere with the fork.

I will here mention that the signaling might be done by cutting in and out resistance by the keys, or by the insertion and withdrawal of an extra battery by the same means; but I prefer to use the method shown.

It is even possible to transfer the controlling-circuit to the signaling-instrument R and S at that moment when the controlling-line is to be opened, the same effect as opening being obtained by polarizing the armatures upon the forks, so that they will respond to a positive current, and causing magnetic effect to cease by cutting in the circuit the signaling-instrument and a negative battery.

The points M′ and N′ of L may be used to open and close another local circuit containing another set of forks, which can be used for another line, extra points of course being added to A to work a similar set of forks.

Having now described my method of obtaining a perfect synchronous vibration of the several forks at the terminals, I will now describe how the second circuit is transferred upon the several signaling-circuits simultaneously.

The line to be transferred is connected first to the springs *g* of fork Q and 13 of fork K. The springs 11 of Q and 15 of K are also connected to the line, when *g* and 13 rest against the limiting-points 10 and 14. The points 12 of Q and 16 of K are in connection with the earth. When the forks Q and K are not in vibration, the springs *g* and 11 of the former and 13 and 15 of the latter are not in contact with either *c d* of K or *e f* of Q, they being so adjusted that the prongs must reach a considerable amplitude before they are brought in contact. This allows the wire to be put to earth at both ends—for instance, starting from the left, and proceeding toward K, the line enters the spring 13; thence, through to point 14, to spring 15; thence to point 16, to earth; from earth at the receiving-station to the point 12 of Q; thence, *via* spring 11, to point 10; thence to spring *g*, to line, thus putting the line to earth each time that the forks Q and K vibrate, and at that period of the vibration when they are in the position they would be if in a state of rest. If, now, both forks vibrate, *c* and *e* will be brought in contact with springs 13 and *g*, thus disconnecting the line from earth, and throwing it to the forks H and P, whose action will be presently described. While this contact continues the other prongs of Q and K recede from 15 and 11, and perform no work. On the return of *c* and *e*, the springs *g* and 13 rest for a moment upon 14 and 10, and as 15 and 11 are, at the particular period, and for a time afterward, in contact with 16 and 12, the line will be put to earth in the manner before described, and will continue in this way until the prongs *d* and *f* come in contact with the springs 15 and 11, separating them from the earth and connecting them to the reeds H and P. Thus it will be seen that the line is split in two parts and put to earth at that period of time when neither H or P are in connection with it.

Having now shown how the wire is split into two parts, I will now describe the method of still further subdivision.

The wires from *e* and *f* of Q and *c* and *d* of K proceed to springs 1 2 of H and 5 and 7 of P. *g*′, 6, 8, and *h* of P are connected to the signaling-instruments W X Y Z and their keys and battery M B′, and the same connections are made with H.

The operation is as follows: When *g*′ of P is in contact with 5, 6 of *h* is in contact with 3. At the same instant that contact is thus made, the forks Q and K connect the wires from *d* and *e* with the line. Now, at the same time, *h* and 7 of P and *a* and 1 of H are in contact, but do not receive a current while *e* of Q and *b* of H are in contact, but immediately they are separated the line is connected to *f* of Q and *a* of H, and they receive a current. Now, as both Z and Z′ and W and W′ are connected at the same time with the splits, it would seem that the waves would mix; but this is not the case, as the forks Q and K make twice as many vibrations per second as P or H. Hence, when both Z Z′ and X X′ at both ends are in connection with the splits *z z z* and *x x x*, these splits do not receive the line simultaneously—first one split receives a wave, immediately afterward the other split receives a wave. Thus a wave passes through the line and signaling-instruments Z and Z′, while no other instruments are receiving it. Immediately after another wave passes through X X′, and no other instrument receives it. Now, when the prongs of P and H pass to the opposite points, connected to W and Y, it is obvious *z* and *y* cannot receive a wave, while W and W′ will receive a wave, immediately followed by a wave, *y y*′. Thus the line is first connected to Z and Z′, then to X and X′, then to Y and Y′, and, lastly, to W and W′, and so on, and, if the time of the various contact-points, as well as the forks, is the same, four series of waves, when all the keys are closed, will be sent over the wires, and each series will pass through its particular instrument, and through none other, and these waves, producing sufficient magnetism in the cores of the relay-magnet, cause it to close, and when one key is opened one series of waves is dropped out, and does not go over the wires, and the corresponding instrument at the distant station will receive no

waves cr electricity whatever. Hence its lever will be withdrawn from the face of the magnet by its retractile spring, and again attracted by closing the key and allowing the dropped series of waves to again pass over the line, and between each series of waves so sent the wire will be put to earth at both ends, and at several points along such wire way-stations are inserted immediately after the cessation of one set of waves and before another commences, thus allowing the wire to discharge its static inductive current, and prevent a mutilation of the signals.

I do not wish to confine myself to any particular form of signaling-instrument, as either magnetical or chemical may be used. Polarized relays may be substituted for common relays, and the keys arranged to transmit reverse currents. Neither do I wish to confine myself to any particular shape of tuning-fork, or arrangement of contact-points, or method of keeping it in motion to accomplish this object, as innumerable combinations may be made by persons skilled in the art. Neither do I wish to confine myself to any particular method of signaling over the controlling-circuit without affecting the forks A and L, as the same may be duplexed, or the forks worked by a rise and fall of tension, and signaling done by reversing the direction of the current, and in various other ways. Neither do I wish to confine myself to any particular method of putting the line to earth between each series of waves, as this can obviously be done in many ways—as for instance, connecting the line to earth at each end before it enters the forks by a resistance-coil, the resistance of the same being made as low as will admit of, and still allow signaling. Neither do I wish to limit myself to the creation of four signaling-circuits, as a multiple fork, making twice as many vibrations as K and Q may have the line pass to it first; thence to K; then by the combination of two forks like H, one with the wires leading to Z′ Y′, and the other with the wires leading to X′ W′

Eight series of waves may be made to pass over the wire, each series of which passes through its particular signaling-instrument and no other, the limit of subdivision being only a question of battery-power, delicacy of signaling-instruments, and accuracy of adjustment.

I will here mention that if ordinary relays are to be used they should be shunted, so as to cause their self-induction to circulate within its own wire, making the current more even for signaling.

I will also mention that several sets of transfer-forks may be included in the same local circuits at all the stations, and worked by the reeds or forks of the controlling-line, thus enabling me to split several lines in the manner described, by the use of only one controlling-line.

Of course, the same object would be attained by using several contact-points and local circuits.

I claim as my invention—

1. The method, substantially as herein described, of subdividing a single telegraphic circuit into two or more independent signaling-circuits by means of vibrating tuning-forks or reeds.

2. The method, substantially as herein described, of subdividing a single telegraphic circuit into two or more independent signaling-circuits by means of vibrating tuning forks or reeds kept in continuous vibration by electro-magnetism.

3. The method, substantially as herein described, of subdividing a single telegraphic circuit into four or more independent signaling-circuits by means of a primary or fundamental fork or reed, and one or more auxiliary forks or reeds, which latter are in respect to the number of their vibrations submultiples of the primary fork or reed.

4. The method, substantially as herein described, of subdividing a single telegraphic circuit into a number of separate signaling-circuits by means of one or more sets of electro-magnetic tuning forks or reeds, each set being composed of one or more forks or reeds, when these are controlled and made to vibrate isochronously by means of a controlling electro-magnetic tuning fork or reed, placed in another and independent circuit.

5. The method, substantially as herein described, of connecting a telegraph-line to earth immediately after it is detached from one set of signaling-instruments, and of disconnecting it from the same before it is placed in connection with another set of instruments.

6. A telegraphic circuit, subdivided at each station into an equal number of independent branches, in combination with two or more isochronous tuning forks or reeds, when the latter are so arranged as to place the main line alternately or successively in simultaneous connection with each pair of branches, substantially as set forth.

7. A telegraphic circuit subdivided at each station into an equal number of independent branches, in combination with two or more isochronous tuning forks or reeds, and two or more sets of electro-magnets for keeping the said forks or reeds in continous vibration, when the latter are so arranged as to place the main line alternately or successively in simultaneous connection with each pair of branches, substantially as set forth.

8. A telegraphic circuit subdivided at each station into four or more branches or signaling-circuits, in combination with a primary turning fork or reed, kept in continuous vibration by the action of the electro-magnets, and one or more similarly-actuated auxiliary forks or reeds, which in respect to the number of their vibrations are submultiples of the primary fork or reed, substantially as set forth.

9. A telegraphic circuit, subdivided at each station into two or more branches or signaling-circuits, by means of vibrating tuning forks or reeds, in combination with another and independent circuit, in which are placed other electro-magnetic tuning forks or reeds, so arranged as to control and render isochronous the vibrations of the tuning forks or reeds at the different stations upon the first-named circuit.

10. The vibrating tuning fork or reed K, in combination with the contact-springs 13 15, contact-points *c* and *d*, and contact-screws 14 16, when so arranged that the line will be momentarily connected directly to the earth while the fork is passing its center of oscillation in either direction, substantially as set forth.

11. The combination of the transfer-reeds and their signaling-instruments, local circuit, and batteries with the main-line reed or reeds, substantially as and for the purpose set forth.

12. The tuning forks or reeds A and L, with their contact-springs, contact-points, and main battery, in combination with the signaling apparatus R and S, substantially as described, and for the purposes set forth.

13. The combination, in one and the same local circuit, of several set of transfer-forks at each of the different stations, substantially as and for the purposes set forth.

Signed by me this 16th day of August, A. D. 1876.

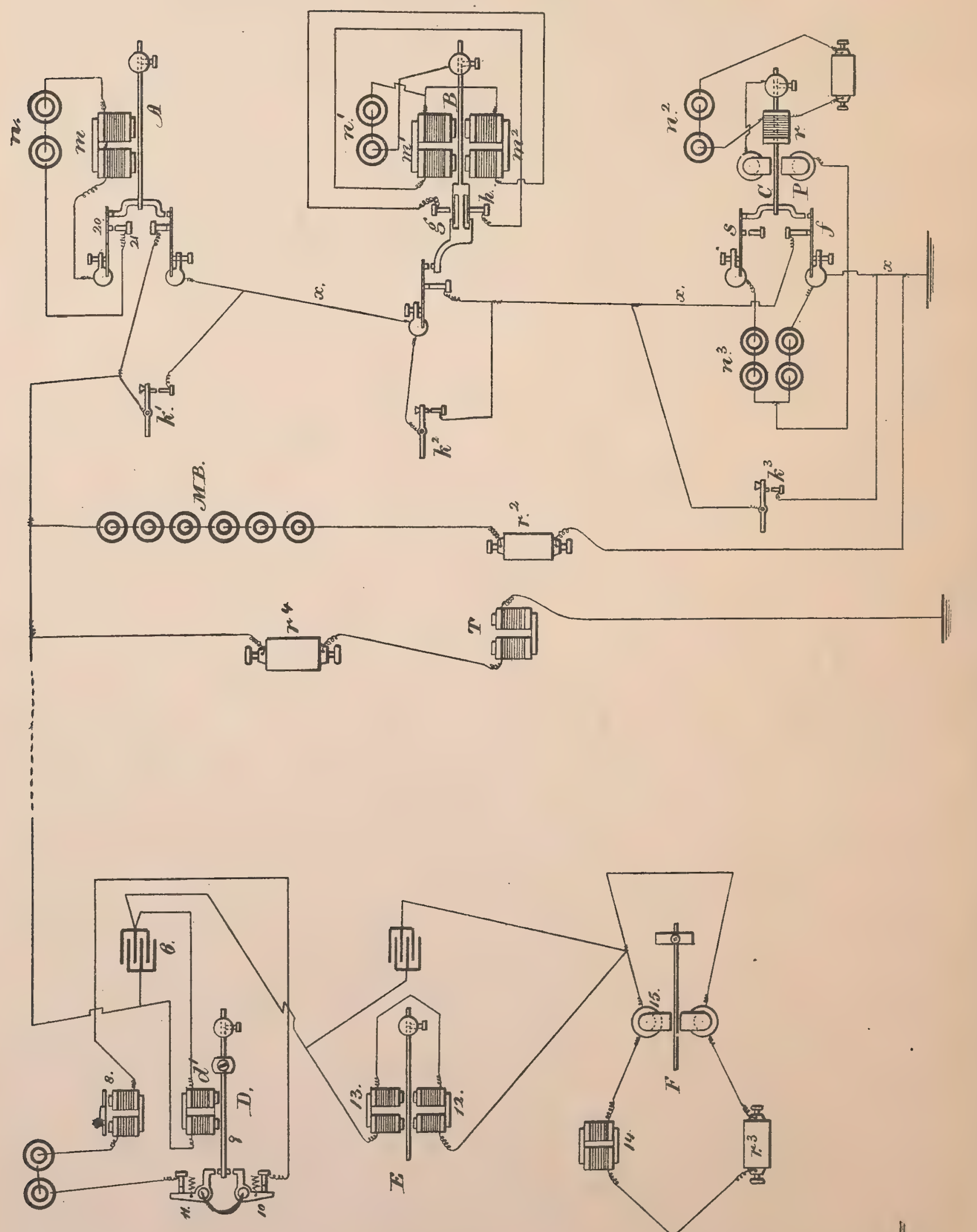
THOS. A. EDISON.

Witnesses:
GEO. D. WALKER,
GEO. T. PINCKNEY.

T. A. EDISON.

ACOUSTIC ELECTRIC TELEGRAPH.

No. 186,330. Patented Jan. 16, 1877.



Witnesses,

Chas. H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell atty

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **186.330,** dated January 16, 1877; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to employ a main battery always in the close circuit of the main line, and to use a short-circuiting wire for that main battery, so arranged with reference to the vibrating reeds that the vibrations shall open and close the short-circuiting wire; hence, the main battery will send its pulsations on the main line when the short circuit is broken.

In the drawing, A, B, and C represent reeds that are vibrated by local circuits and electro-magnets, and they are of varying tones, so as to vibrate in different periods of time, and the vibrations of the reeds are made to open and close the local circuits. The reed A is provided with an electro-magnet, m, local circuit and battery n, and contact-points 20 21, that are opened as the reed is attracted by the electro-magnet; hence the vibrations will be continuous.

The reed B is between two magnets, m^1 m^2, and these are connected in local circuits from the battery n^1, and there are at opposite sides of the reed B the contact-points g h, and the wires are arranged so that when the reed closes against g the circuit passes through B from n^1, and by g through m^2 to n^1, attracting the reed from g, and when the reed closes against h the current is thrown through m^1. This insures uniformity in the vibrations of the reed as the powers operating are equal upon both sides of it, and the movement will be equal each way from a state of rest, regardless of the power of the battery. The reed C passes through the helix r, and hence it is magnetized by the current from a local battery, n^2. The reed C might be a permanent magnet; but I prefer to magnetize it by a helix. These are two lateral cores from the electro-magnet P, at opposite sides of the reed C, and the battery n^3 is connected to the circuit-closing points f s, between which is the reed c, the middle of the battery connected to the magnet P, and thence to the reed C. By this arrangement of circuits the current through P will be in first one direction and then the other, and the polarity of the cores alternately changed to act by attraction and repulsion equally, first one way and then the other upon the reed. This causes the vibrations of the reed to be very regular and uniform, and prevents sluggishness by residual magnetism.

The keys k^1, k^2, and k^3 are in branch wires of the short-circuiting wire x, and the normal position of these keys is open, and as the wire x would short-circuit the main battery M B, if the contact-points of the respective reeds were all closed there would not be any current sent upon the line; but a pulsation will be sent for each break made in the short-circuiting wire x; hence, the pulsations will pass over the line-wire according to the times of vibration of the various reeds. Whichever key k^1, k^2, or k^3 is closed the corresponding reed A, B, or C will cease to send waves upon the line, as its contact-points will be short-circuited, and hence the corresponding reed, at the distant station, will come to a state of rest and close their local circuits, or otherwise produce the given signal.

The rheostat r 2 is introduced to form a resistance in the short circuit and to lessen the sparks at the contact-points. The rheostat r 4 and electro-magnet T are introduced in a branch from the main line to the earth, either at the transmitting or receiving station to allow a portion of the current to pass to earth, and by the discharge of the electro-magnet to set up a counter-current that neutralizes the static charge of the line.

The receiving-instrument D is provided with the reed 9, that is vibrated by the electro-magnet d' in the main line, and there is a shunt-circuit containing a condenser, 6, which serves to neutralize the effect of the self-induction in the magnet, and to lessen the risk of the reed being affected by the currents that pass through the magnet, and pulsate at a different rate to the vibrations of this reed 9.

I find in practice that in an acoustic telegraph a condenser acts, in connection with the magnet, to increase the length of vibration of the reed, while under similar circum-

stances a condenser used with an ordinary sounder causes it to stick and have a tardy movement.

The levers 10 and 11 are applied at opposite sides of the vibrating end of the reed, and increase the motion at the contact-points, which close and open the local circuit to the relay or sounder magnet 8.

The reed E is between the cores of the electro-magnets 12 and 13, and the helices of these magnets are both in the main-line circuit. The cores of one of these magnets is covered with a metallic tube, which causes a circulation of the self-induction currents of the magnet, and prevents the rapid demagnetization of the cores. This produces in the magnet 12, containing such tube, nearly a constant attractive force, and in the other magnet 13 will receive clear sharp impulses. This construction is advantageous, because the electro-magnet 12 is a constant attractive force, that prevents the reed responding to pulsations in 13 that do not correspond with its time of vibration.

The polarized reed F is between the two projections of the magnet 15, and 14 is an electro-magnet with its armature in contact with its cores, and this magnet is in the branch wire running through one of the spools of the magnet 15, and in the other branch wire passing through the other spools is a rheostat, r^3. The current from the distant station produces no direct effect in 15, but the induced current set up in the magnet 14, reacting through the magnet 15, produces vibrations of the reed when those pulsations harmonize with its period of vibration.

I claim as my invention—

1. The main battery M B, and short-circuiting connection x, both between the line and the earth, in combination with a series of reeds or vibrating transmitting-instruments and contact-points opened and closed by the reeds, substantially as set forth.

2. The magnets m^1 m^2, vibrating reed B, circuit-closers g and h, local battery n', and connections, arranged substantially as set forth, whereby the circuits, through the respective magnets, are entirely broken alternately by the vibration of the reed, as specified.

3. The combination, with a polarized vibrating reed, of an electro-magnet and circuits, substantially as set forth, whereby currents of alternating polarity are passed through the electro-magnet by the circuit-closers that are operated by the reed, substantially as set forth.

4. The combination, with the main battery and shunt between the line and earth, reeds, and contact-points, operated by such reeds, of finger-keys placed in short circuits around the circuit-closing points, substantially as set forth.

5. In an acoustic telegraph receiving-instrument, the combination, with the receiving-magnet, of a condenser, in a shunt around such magnet, substantially as set forth.

6. The combination, with the reed 9, of the levers 10 and 11, contact-points, local circuit, and receiving magnet or sounder 8, substantially as set forth.

7. The magnets 12 and 13, at opposite sides of the vibrating reed, and in the main-line circuit, with tubes around the cores of one of the magnets, for the purposes set forth.

8. The magnet 15, with its cores in branches of the main line, in combination with the polarized reed induction-magnet 14, and resistance R^3, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

THOS. A. EDISON.

Witnesses:
J. D. Russ,
Chas. Batchelor.

2 Sheets—Sheet 1.

T. A. EDISON.

TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

No. 186,548. Patented Jan. 23, 1877.

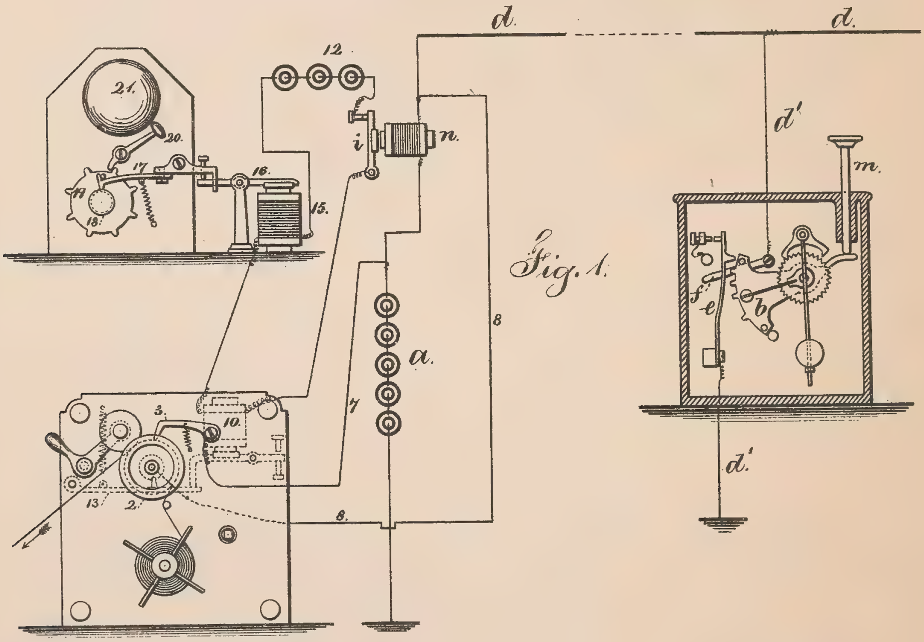
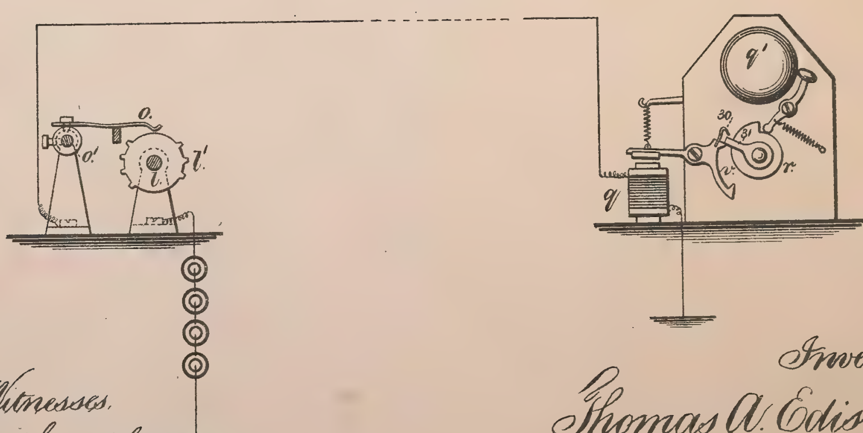


Fig. 1.

Fig. 2.



Witnesses.
Chas H. Smith
Harold Serrell

Inventor.
Thomas A. Edison.
per Lemuel W. Serrell
att.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

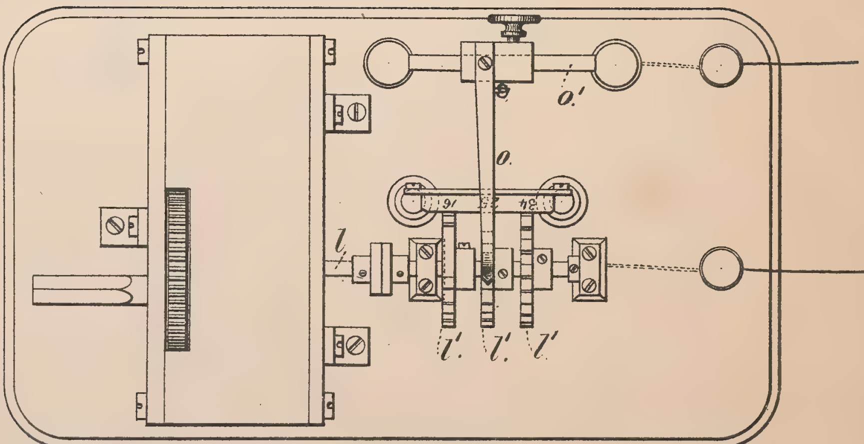
2 Sheets—Sheet 2.

T. A. EDISON.

TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

No. 186,548. Patented Jan. 23, 1877.

Fig. 3.



Witnesses

Chas H. Smith

D. P. Cowl.

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON. D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE DOMESTIC TELEGRAPH COMPANY, OF NEW YORK.

IMPROVEMENT IN TELEGRAPHIC ALARM AND SIGNAL APPARATUS.

Specification forming part of Letters Patent No. **186,548,** dated January 23, 1877; application filed May 18, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in District and Fire-Alarm Telegraphs, of which the following is a specification:

The object of this invention is to provide a cheap and reliable alarm, adapted to small cities and towns, for giving fire-alarms or other signals.

I make use of a central station, with one or more lines running to the respective signal-instruments, which may be similar to those shown in Letters Patent No. 169,972, and are placed in a branch running to earth. When the signal-instrument is operated an alarm is given at the central station to call attention, a record is made of the signal upon chemical paper, and the operator, by a revolving circuit-breaker, rings a bell or bells in the engine-house, or wherever the alarm has to be sounded, giving the location by the number of taps of the bell, to show where the fire is, or the call that requires to be answered.

In the drawing, Figure 1 is a diagram illustrating the circuit-connections from a central station to one distant signal-box; and Fig. 2 shows the circuits from the central station to the engine-house or other location to which the signal is to be sent; and Fig. 3 is a plan of the instrument employed to signal such engine-houses or other station.

The main battery *a* is connected to the earth and to the line-wire *d*, and from this one or more branches, *d'*, pass to earth, and in each such branch there is a signaling-instrument, adapted to be operated for sending pulsations denoting numbers, and by operating this instrument the circuit is closed and again broken when the signal has been given. An instrument of this general character is shown in the Patent No. 169,972, with the exception that the segment *b* has teeth upon it that operate the circuit-closing spring *e*, and when the segment is being turned by pushing in the rod *m* the switch *f* is moved to close the branch circuit to the spring *e*, and when the segment falls again, giving the pulsations through the circuit-closer *e*, the switch *f* is moved back during the latter part of the movement of *b* and breaks the circuit of *e*, so that one set of signals only will be given. The signal is received at the central station on chemical paper, the circuit passing, by 7, from the main line through the stylus 3, and drum 2, and back, by 8, to the line at the other side of the electro-magnet *n*. By this arrangement the resistance of *n* causes a portion of the current to pass through the chemical paper, and the discharge from the said magnet *n*, when the circuit is broken, sets up a current of opposite polarity, to render the marks on the chemical paper sharp and distinct. The chemically-prepared paper is on a reel, which may be placed in a case, so as to keep it moist. The electro-magnet *n* operates an armature, *i*, that is in a local circuit from the battery 12, and in this is an electro-magnet, 10, that operates the trip 13 of the clock-work used to revolve the drum 2 and move the chemical paper, so that as soon as the circuit of *n* is closed and its armature attracted the local circuit from 12 is broken, the armature of 10 falls back and releases the trip or stop of the clock-work, and the paper is moved by the drum to receive and record the pulsations of the signal. The magnet 15 in the circuit from 12 operates the trembler 16, which is an armature-lever acting upon a dog, 17, in the screw 18 upon the shaft of spur-wheel 19, operating the hammer 20 of a bell, 21. The wheel 19 and screw 18 are revolved by clock-work for ringing the bell, and this ringing will continue until the circuit through 15 remains closed long enough to allow the screw to move the dog 17 endwise of the screw until it arrests by a stop the movement of the clock-work. The alarm-bell 21 is rung, as aforesaid, as soon as the circuit of *d* is closed, at the distant station, so as to call the attention of the attendant to the message received upon the chemical paper.

At the central station the attendant has a clock-movement with a shaft, *l*, upon which are break-wheels *l'*, with conducting peripheral projections, and there are as many break-wheels as there are signal-stations or characters of signals to be received at the central office. There is also a contact-spring, *o*, adjustable upon a rod, *o'*, so that it may be moved along to come in contact with either of the break-

wheels. As soon as a signal is received the attendant moves the spring *o* along into contact with the wheel corresponding to the signal received. A battery is in circuit with this wheel *l′*, and the spring *o* leads to the line-wire that runs to an engine-house or other place where the signal is to be given, and there energizes the electro-magnet *q* and gives pulsations or taps upon a bell, *q′*, corresponding, as to length of duration and intermediate pauses, with the break-wheel *l′*, with which the spring *o* is in contact. I prefer and use a cam, *r*, that is revolved by clock-work and moves the bell-hammer, and the escapement *v* controls the revolution of this cam, such escapement being connected with the armature of the electro-magnet, and having a spring-finger, 30, at one end to arrest the arm 31 on the cam-shaft, and thereby prevent a sudden stoppage of the momentum of the cam and gearing. This spring yields as the arm passes it, so as to prevent concussion or rebound, and as the pallets of the escapement are moved by the electro-magnets the cam of the bell is allowed to revolve and ring the bell, giving the proper number of taps, according to the number of the station from which the alarm proceeds.

The solution used for moistening the chemical paper is preferably composed of a solution of pyrogallic acid, chloride of sodium, or other conducting substance, and a salt of strontia.

I claim as my invention—

1. The segment *b*, with points upon its edge, in combination with the circuit-closing spring *e* and switch *f*, operated by the movement of the segment, as set forth.

2. The receiving-instrument, provided with a trip for the actuating-gearing, in combination with the electro-magnet to move the trip and the roller 2 and stylus 3, substantially as set forth.

3. The local circuit electro-magnets *n* and 15, in combination with the call-bell 21, trembler 16, and chemical recording-instrument, substantially as set forth.

4. The transmitting-instrument, provided with a revolving shaft and circuit-closing wheels corresponding to the signals of the various signaling-instruments, and a movable contact-spring, arranged and operating substantially as set forth.

5. The bell signaling-instrument, constructed with a revolving cam to operate the hammer, a spring-stop upon the escapement, and an electro-magnet to operate the escapement, substantially as set forth.

Signed by me this 9th day of May, A. D. 1876.

THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

F. L. POPE & T. A. EDISON.

Assignors by mesne assignments to the Gold and Stock Telegraph Company.

PRINTING TELEGRAPH.

No. 7,621. Reissued April 17, 1877.

Fig. 1.

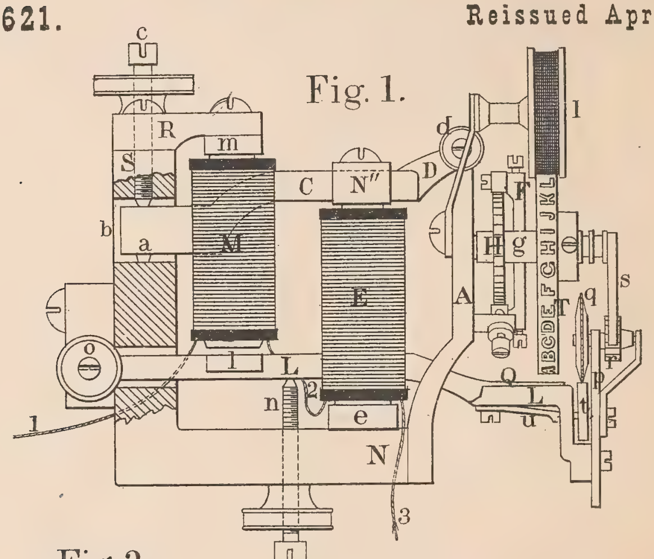


Fig. 2.

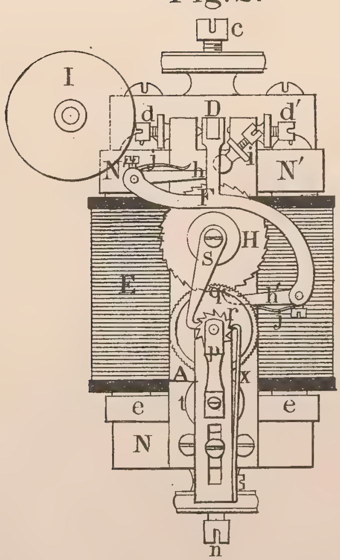


Fig. 3.

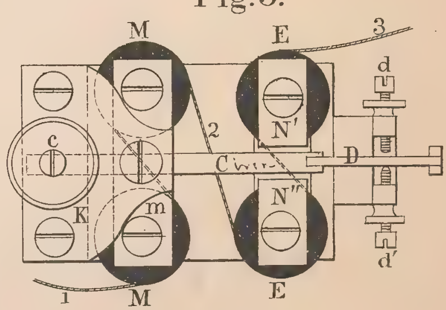


Fig. 4.

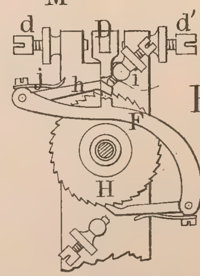


Fig. 5.

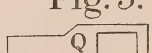
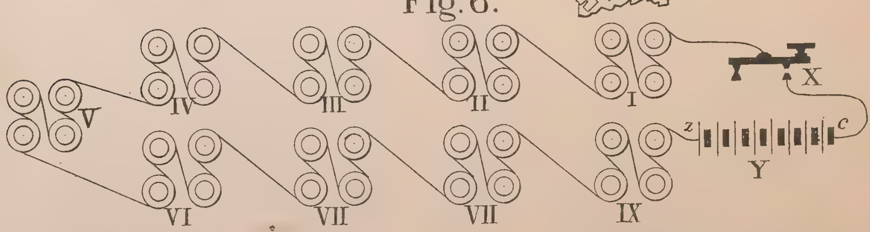


Fig. 6.



Witnesses: Geo. B. Prescott. Jr. Geo. A. Hamilton.

Inventors: Frank L. Pope. Thomas A. Edison. by Frank L. Pope. Atty.

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, AND THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE GOLD AND STOCK TELEGRAPH COMPANY.

IMPROVEMENT IN PRINTING-TELEGRAPHS.

Specification forming part of Letters Patent No. 102,320, dated April 26, 1870; reissue No. **7,621**, dated April 17, 1877; application filed March 21, 1877.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union, and THOMAS A. EDISON, now of Menlo Park, in the county of Middlesex, both in the State of New Jersey, have invented certain new and useful Improvements in Printing-Telegraphs, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings:

Our invention relates to that class of printing-telegraph instruments in which the type-wheel is caused to rotate by means of a step-by-step escapement actuated or controlled by the armature of an electro-magnet in the main circuit, and when any desired character upon the type-wheel has been brought round to a given point an impression of such character may be printed by bringing into action a second armature controlled by the same circuit.

Our improvements consist, first, in a method of imparting to the type-wheel an intermittent rotary motion by the action of successive alternate positive and negative currents of short duration, and of locking the type-wheel at any point, and at the same time printing a letter or character by prolonging the duration of the final current, whether the same is positive or negative; second, in the combination of a type-wheel, actuated or controlled by a polarized armature, under the influence of alternate reverse currents of short and uniform duration, with a device for giving the impression which is actuated or controlled by a non-polarized or neutral armature, the arrangement being such that the type-wheel may be locked, and the neutral armature brought into action to effect the printing when the type-wheel has been brought to the required point by prolonging the duration of the final current, without reference to its polarity; third, in certain improved combinations of the mechanism of the several parts of the apparatus, whereby the efficiency and reliability of its action are materially increased.

In the accompanying drawing, Figure 1 is a side elevation of the receiving apparatus. Fig. 2 is an end elevation of the same, the type-wheel being removed. Fig. 3 is a plan view of a portion of said apparatus. Fig. 4 is a detached view, showing the details of the escapement in said apparatus. Fig. 5 is a plan view of the slotted presser, and Fig. 6 is a skeleton diagram, showing the arrangement of a number of instruments located at different stations, and placed in the same electric circuit, operated simultaneously in unison by a battery placed at one point in the circuit.

Similar letters refer to like parts in the different figures.

E, Figs. 1, 2, and 3, designates a perpendicular electro-magnet, composed of two cores of soft iron, united below in the ordinary manner by a cross-bar, *e*, also of soft iron. The north pole of an angular permanent magnet, N S, is screwed to the cross-bar *e*, to which it communicates north polarity beyond the point of contact, and also to both cores and poles of the electro-magnet E. The soft-iron armature C is supported upon a pivot, *a*, in a slot, *b*, in the south end S of the permanent magnet N S, from which it receives south polarity, being secured in that position by a screw or otherwise. The said slot is situated at a short distance from the end of the magnet, exactly at the point of greatest magnetic intensity, so that the pivot end of the armature is completely surrounded by the magnetic mass, and becomes subject to the greatest possible amount of inductive influence.

The armature C is so placed that it is free to vibrate to and fro in a lateral direction between the poles N′ and N″ of the electro-magnet E. When this is arranged, it is obvious that the north polarized ends N′ and N″ will each exert an equal attraction upon the south polarized armature C when the same is equidistant from each, but that it will be attracted and firmly held by either N′ and N″ when placed in close proximity or contact with one or the other. An arm, D, projects from the end of the armature C, passing between screw-stops *d* and *d′*, by means of which its lateral vibration is controlled and limited. This arm is constructed of brass or other non-magnetic metal, in order to prevent the inductive magnetic action from extending beyond the poles N′ N″ of the electro-magnet E.

The screw-stops d and d' are supported by a standard, A. Upon this standard is secured a shaft, f, Fig. 4, upon which is a sleeve, g, carrying a ratchet-wheel, H, and a type-wheel, T, upon the circumference of which type-wheel are engraved such letters, numerals, or other characters as may be required. The characters on the type-wheel are supplied with ink by means of a fountain ink-roller, I, secured to a movable arm attached to the standard A. The vibrating arm D carries a curved bar, F, to the extremities of which are pivoted pawls h and h', which act respectively at opposite points upon the circumference of the ratchet-wheel H; as shown in Figs. 2 and 4.

The to-and-fro movement of the pawls, as well as each successive step in the forward movement of the wheel H, which is driven by them, is limited by the adjustable stops i and i'. The pawls are pressed against the teeth of the wheel by springs $j\ j'$; and when the arm D vibrates to and fro, the pawls alternately fall into the interdental spaces of the wheel H and push it forward until the movement of the pawl, and consequently that of the wheel, also, is arrested by the stop i or i', which may be adjusted so as to allow of any desired amount of movement of the pawls h and h'. But we will here remark that the pawls h and h' may be made of spring-steel, and so arranged as to automatically bear in the interdental spaces of the wheel H, in which case the springs $j\ j'$ may, of course, be dispensed with.

By means of the above-described arrangement the to-and-fro vibrations of the arm D may be caused to communicate, through the pawls, a rapid intermittent rotary motion to the ratchet-wheel H, sleeve g, and type-wheel T in the direction shown by the arrow marked thereon. The screw-stops $d\ d'$ are so adjusted in reference to the stops $i\ i'$ that when the armature C is acted upon by a powerful current, tending to bend or otherwise disarrange the pawls $h\ h'$, ratchet-wheel H, and their appurtenances, the slightest deflection of the arm D, after the pawls h or h' have come in contact with the stops i or i', will bring said arm D against one of the stops d or d', thereby relieving the mechanism from undue strain or pressure.

The manner in which the vibration of the armature C and arm D is made to revolve the ratchet-wheel H will be understood more clearly by reference to Fig. 4. Suppose the arm D to be moved from its position, as shown, toward the left, carrying with it the bar F and the pawls $h\ h'$, the pawl h' will engage with a tooth of the wheel H, and carry it forward in the direction of the arrow until its movement is arrested by the pawl coming in contact with the stop i'; at the same time the pawl h will slip over one tooth of the wheel without obstruction. When the arm D, bar F, and pawls $h\ h'$ are moved from left to right the operation of the respective pawls is reversed, although the wheel H continues to be moved in the same direction, as before. Each vibration of the arm D either to the left or to the right therefore advances the ratchet-wheel H the distance of one tooth.

The apparatus for taking the impression after the type-wheel has been brought to the desired position may be described as follows: M, Figs. 1 and 3, is an electro-magnet of the usual form, its poles being united by the cross-bar m, which is secured by a lug, K, to the south end S of the permanent magnet N S. This lug is made of non-magnetic metal, for the purpose of cutting off the magnetic induction which would otherwise take place between the permanent magnet N S and the soft-iron cores of the electro-magnet M.

The armature l of this electro magnet is of soft iron, and attached to a lever, L, one end of which is pivoted at O, and which passes through a slot in the standard A. The lever is capable of a vertical movement upon O as its fulcrum, the extent of such movement being limited in one direction by the face of the type-wheel T, and in the other by the adjustable screw-stop n.

To the extremity of the lever L is attached a slotted adjustable standard, R, carrying a wheel, q, with a sharp serrated edge. Upon the same shaft with said wheel q is a ratchet-wheel, r, actuated by a hook-shaped pawl, s, attached to the extremity of the shaft f. A roller, t, of hard rubber or other suitable material, is mounted upon a spring-axle, u, in such a manner as to be pressed firmly against the serrated edge of the wheel q. A ribbon of paper (not shown in the drawing) may be made to pass horizontally across the lever L and beneath the slotted presser Q, (shown in plan in Fig. 5,) the edge of said paper passing between the serrated wheel q and the roller t in such a manner that the rotation of the wheel q will cause the ribbon to be drawn forward from right to left. The slotted presser Q serves to keep the paper from coming in contact with any portion of the type-wheel, except the letter of which the impression is desired. The two electro-magnets E and M are placed in the same electrical circuit, the connections being arranged as shown in Fig. 3.

The manner in which the above-described apparatus is actuated by means of electric currents is as follows:

If a momentary current of electricity be sent from the positive pole of a battery through the electro-magnets E and M, its tendency would be to magnetize the pole N' of the electro-magnet E "north" and the pole N'' "south," but as both poles were previously north by the inductive influence of the permanent magnet N S, the effect of this current is to strengthen the north magnetism of N' and to weaken or entirely destroy that of N''. The armature C is therefore attracted to N' with double force, and remains on that side after the cessation of the current, being still attracted by the pole F', whose distance from C is now much less than that of N''.

If, now, a momentary negative current is sent, this effect is reversed. The pole N″, in turn, attracts the armature, and it moves to that side, remaining until the polarity of the exciting-current is again changed.

Thus, by transmitting through the helices of the electro-magnet E a rapidly-alternating series of short positive and negative currents, it will readily be understood that the armature C and its attachments may be caused to vibrate to and fro with great rapidity, causing a correspondingly rapid revolution of the ratchet-wheel H and type-wheel T, and that the latter may readily be brought to any required position simply by transmitting in succession the requisite number of alternate positive and and negative currents through the electro-magnet E. These alternate currents of short duration necessarily traverse the coils of the electro-magnet M, which is included in the same circuit, but the armature of the latter is not affected by them. The reason of this is, that a polarized or permanently magnetic armature responds much more promptly to the attraction of an electro-magnet than a non-polarized or neutral armature, other conditions being the same, and therefore the polarized armature C of the magnet E responds perfectly to the short alternate currents, while the more sluggish non-polarized or neutral armature *l* remains at rest.

In order, therefore, to print an impression of any desired character upon the type-wheel, a succession of alternate positive and negative currents is sent through the wire 1 2 3, Figs. 1 and 3, of such short duration as not to affect in any manner the neutral armature *l* of the electro-magnet M, while by the action of the polarized armature C of the electro-magnet E, the type-wheel T may be revolved until the desired character upon its circumference is brought opposite the impression-lever L. The duration of the final current is then prolonged, the effect of which prolongation is to cause the type-wheel to be firmly locked in its position (the pawl *h* or *h′* being wedged between the point of the stop *i* or *i′* and a tooth of the wheel H,) and to allow sufficient time for the neutral armature *l* of the electro-magnet M to act, which raises the lever L, and brings the paper ribbon in contact with the type upon the wheel T, the same having been previously inked by the fountain-roller I.

The armature *l* being of soft iron and neutral, it is immaterial, so far as the result is concerned, whether the prolonged terminal current is positive or negative, as it responds with equal certainty in either case. When the attraction of the electro-magnet M ceases the lever L falls back to its original position. At the same time the hooked pawl *s* catches a tooth of the ratchet-wheel *r* and causes it, together with the wheel *q*, to revolve a short distance, thus drawing the paper ribbon forward and leaving a clear space in readiness for the next impression.

A click, *x*, prevents the ratchet-wheel *r*, and, consequently, the wheel *q*, from revolving in the opposite direction.

The downward movement of the lever L may be assisted by a retracting-spring, if necessary.

It will be understood from the above description that this apparatus may be actuated entirely by electro-magnetic power, derived from the battery at the transmitting-station, without the assistance of local or secondary batteries, or of mechanical power derived from any source other than the said battery at the said transmitting-station, and that any required number of such apparatus may be placed at various points included in the same electric circuit, and operated simultaneously in unison by the action of a single battery placed at the transmitting-station.

This will be more clearly understood by reference to Fig. 6, where we have given a skeleton diagram illustrating an arrangement of instruments in connection with a main battery and circuit-breaker, whereby an operator can at one point form a connection with a main battery, so as to complete an electric circuit, in such manner that the current of said battery shall pass through as many instruments on a main line unprovided with local batteries as desired, and record simultaneously, in printed characters, at each instrument the same message.

For instance, at a point lettered X there may be located a circuit-breaker of any suitable construction, and at the point lettered Y a main battery of sufficient power, or in lieu thereof a number of small main batteries, located at such point, or elsewhere in the main circuit, that a current may be caused to pass from the main battery or batteries through the electro-magnets I, II, III, &c.

It is obvious that other electro-magnets can be placed in the same circuit for effecting other useful purposes, such as striking bells to call attention, &c., which may be actuated by increasing the strength of the electric current which operates the printing mechanism. It is also obvious that a local battery may be employed to bring into action a magnet not in the same circuit, by insulating one of the stops, *d d′*, upon the standard A, and connecting it with the local circuit in such manner that the rapid vibrations of the arm D will not allow it to remain in contact with the stop long enough to permit the local or secondary battery to charge its electro-magnet; but when the vibrations are made to cease by the action of the transmitting-operator, or otherwise, the arm D will remain in contact with the stop *d′* a sufficient time to allow the secondary electro-magnet to become charged.

We do not confine ourselves to the particular form and arrangement of parts shown in the drawings. There are numerous and well-known means of producing the vibratory movement of a lever by the use of alternate positive and negative currents, in combination with a per-

manent and an electro-magnet acting upon each other, and of applying the same to the movement of a type-wheel. Neither do we wish to confine ourselves to any particular method of producing or transmitting alternate positive and negative currents for the purpose specified, as there are many well-known appliances for these purposes, which have heretofore been used in connection with other printing instruments, and may be employed in like manner with advantage in connection with our improved apparatus.

We claim as our invention—

1. The method, substantially as herein specified, of operating a printing-telegraph by first moving the type-wheel into any required position by the action of alternate positive and negative currents of short and uniform duration, and then locking the type-wheel in such position and at the same time causing the printing to be effected by prolonging the duration of the current last sent, irrespective of its polarity.

2. A type-wheel actuated or controlled by the to-and-fro movements of a polarized armature, under the influence of alternate positive and negative currents of short duration, in combination with an impression device actuated or controlled by a neutral armature, when the arrangement is such that the type-wheel may be locked at any required character, and the neutral armature brought into action to effect the printing of such character, by prolonging the normal duration of one of the said alternate currents, whether positive or negative.

3. The combination of the safety-stops d d' with the stops i i' and armature-lever D, substantially as and for the purpose specified.

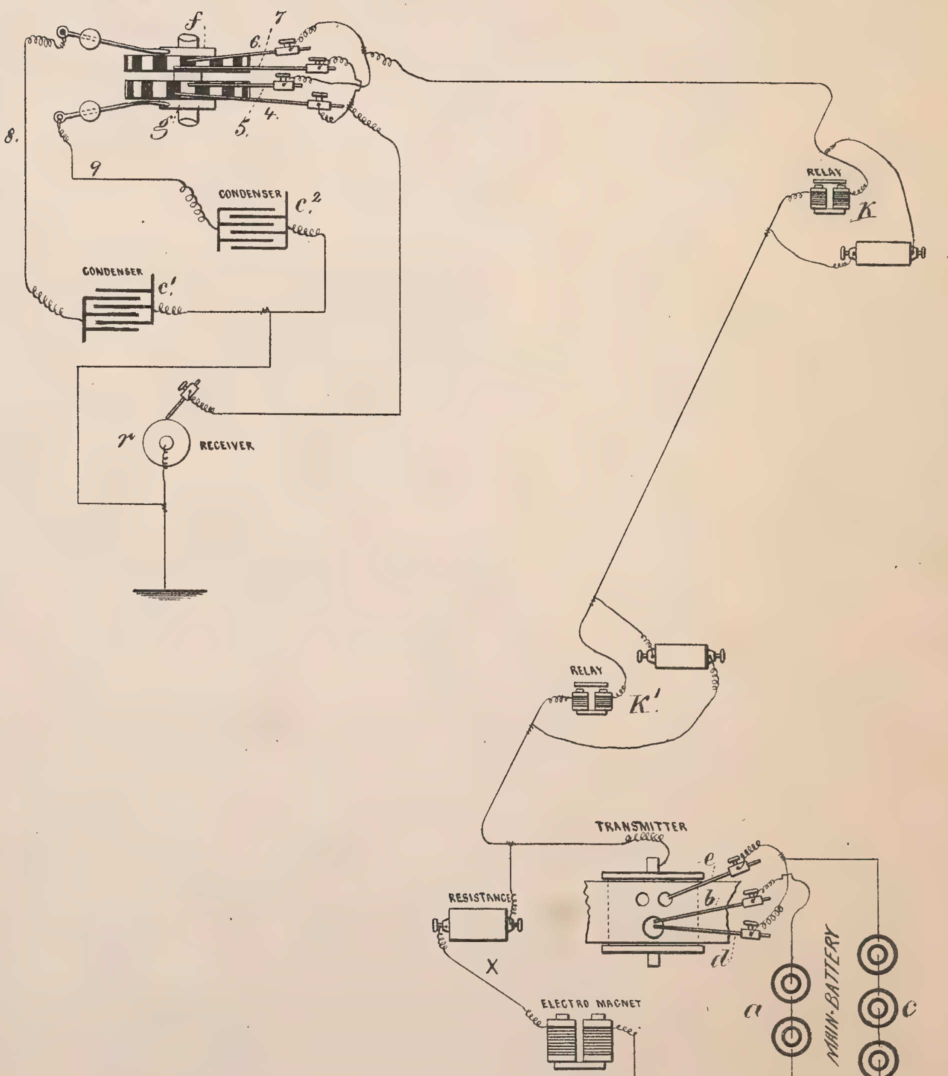
In testimony that we claim the foregoing we have hereunto set our hands this 21st day of February, 1877.

FRANK L. POPE.
THOS. A. EDISON.

Witnesses:
JOHN C. HUBBARD,
RANDOLPH HURRY.

T. A. EDISON.
AUTOMATIC TELEGRAPH.

No. 195,751. Patented Oct. 2, 1877



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison
per L. W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **195,751**, dated October 2, 1877; application filed January 27, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

This invention is for bringing into operation condensers by alternately connecting and disconnecting them from the line by revolving wheels having alternate conducting and non-conducting surfaces.

In the accompanying diagram the improvement is illustrated.

At the sending-instrument the battery is divided, the part *a* being connected to the stylus *b*, and the part *c* to the stylus *d* and *e*, and these are so arranged for the purpose of weakening the middle portion of the dash, because the stylus *b* drops into the large perforations for a dash near the edge of that perforation, and remains a less time than the stylus *d*, and at that time throws into action a local circuit from the smaller battery *a*, that is opposed to that of the main battery *c*, and thus lessens the current in the middle of each dash-mark.

X is an ordinary branch circuit at the sending end for the static discharge from the line.

K K′ are signaling Morse relays used along the line. The helices of these relays are not to exceed one inch in length, and the coils are shunted with a resistance equal, or nearly so, to the resistance of the coils on said relays, so as to provide a route for the induction set up in the coils to circulate without going out upon the line to mutilate the signals.

The natural effect of this induction-current circulating within this circuit is to make the relay stick; but I have found that by decreasing the length of the cores and coils, the induction is decreased to such an extent that this result does not follow.

Two wheels or surfaces with alternating conducting and non-conducting surfaces *f* and *g* are employed in connection with the circuit-closing springs or points 4 5 6 7, and these wheels are revolved rapidly when the instrument is in work.

The hubs of *f* and *g* are connected by the wires 8 and 9 with the condensers C^1 C^2. The springs 5 and 6 are connected with the line, and 7 and 4 to the receiving-instrument *r*.

The condensers C^1 C^2 are, by preference, condensers in air without intermediate sheets of paper.

The wheels *f g*, in the act of rotating, connect the condenser C^1 in the circuit of the line at the same moment that the condenser C^2 is connected to the receiving-instrument. This is then disconnected and connected to the line, and C^1 connected to the instrument.

In alternately throwing these condensers, first on the line and then on the chemical receiving-instrument, with great rapidity, signals made on the line at the distant station charge these condensers, and the condensers transfer these charges to the receiver without it having any connection whatever with the line.

As the condensers can be made to hold these charges for a length of time, it follows that by this method currents sent on one line may be transferred by condensers into another line, or to a short circuit containing a chemical receiving-instrument. By this means the static effects are nearly overcome, and perfect signals are recorded.

I do not wish to confine myself to any particular mechanism for operating the condensers; but

I claim as my invention—

1. The method herein specified of transferring the signals of one electric circuit into another circuit by revolving circuit-closing wheels with conducting and non-conducting surfaces and connections to condensers and to the chemical recording-instrument, substantially as set forth.

2. The transmitting-instrument provided with a circuit-closing point and opposing battery for lessening the battery-power in the middle portion of the pulsation for a dash, as set forth.

Signed by me this 18th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
AUTOMATIC TELEGRAPH.

No. 195,752. Patented Oct. 2, 1877.

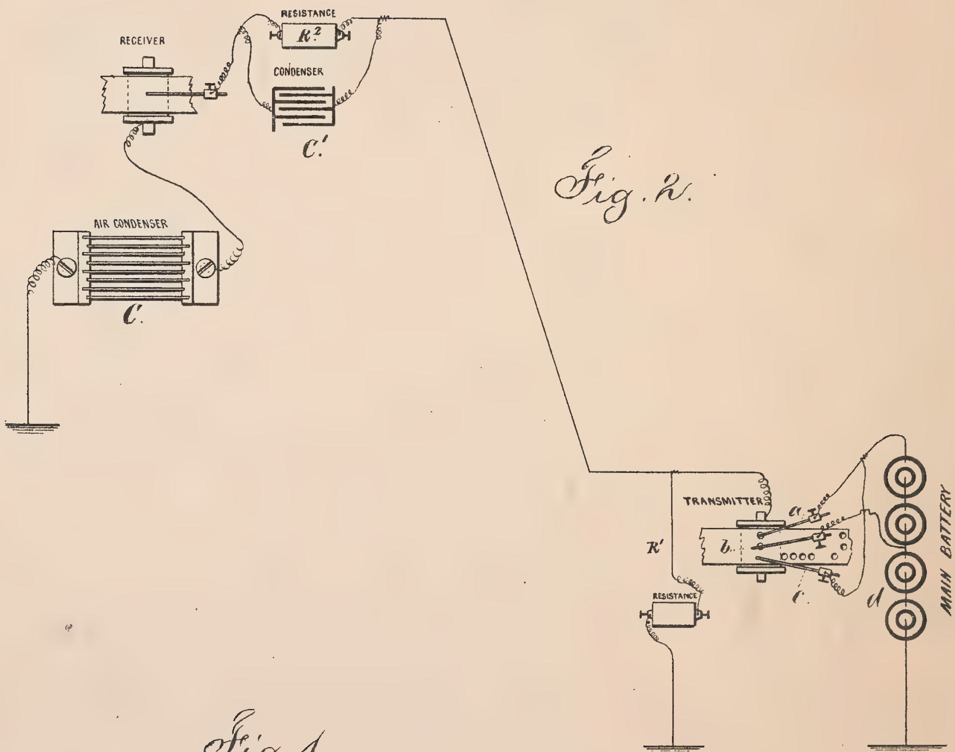
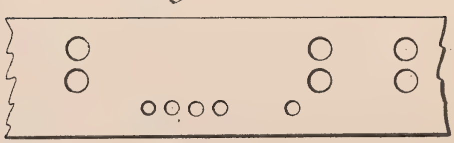


Fig. 2.

Fig. 1.



Witnesses;

Chas H Smith
Geo. T. Pinckney

Inventor.

Thomas A. Edison.
per L. W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF AND GEORGE HARRINGTON, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **195,752**, dated October 2, 1877; application filed January 27, 1875.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Automatic Telegraphs, of which the following is a specification:

The object of this invention is to transmit, over telegraphic circuits, dashes the first part of each of which is formed by a stronger current than the last, so as to prevent the wire from being fully charged statically; also, in arranging in the main line at the receiving-station a condenser formed of plates separated by air only.

The invention consists in the method of arranging the perforations and contact stylus or rollers to send a strong current by putting on the whole of the battery to form the first part of a dash, and immediately thereafter a second stylus closes the circuit through one of the holes intended for a dash, so as to preserve the continuity, but only to put on a portion of the battery.

Figure 1 shows the arrangement of perforations for the word "That," and Fig. 2 shows the arrangement of parts and connections.

The first stylus, *a*, passing into the first hole, closes the circuit, and puts the whole battery *d* upon the line. Just at the moment it is leaving this hole the middle stylus or pen *b* falls into the second hole, preserving the continuity of the circuit, but putting on only half of the battery. The third pen, *c*, puts on the whole of the battery, and forms the dots.

If the ends of the stylus or pens are in line, one perforation will be in advance of the next to form the dash; but if the point of one stylus is farther in advance than the next, the perforations may be in line with each other transversely of the strip, and two styluses in place of three might be similarly employed.

R^1 is a branch to earth for the static discharge of the line. C' is an ordinary condenser, shunted with a resistance, R^2, the object of which is to give a more powerful compensation should the air-condenser C prove insufficient; but generally the resistance R^2 is made *nil* or short-circuited, so that the condenser C' is dispensed with. The first portion of a signal coming over the wire records itself on the chemically-prepared paper, and at the same time charges the condenser C. Now, when the signal ceases, the condenser C discharges a contrary current, which balances that from the line.

The reason of sending a weaker current to form the last portion of a dash is to prevent the wire from being charged higher with a dash than a dot, thus preserving an evenness in the recorded dots and dashes which it is very hard to obtain on very long circuits.

I use an air-condenser, C, so that it will discharge instantly, which is not the case with condensing-surfaces separated with a non-conducting material, the phenomenon of absorption preventing their discharging quickly and reducing the speed.

I believe I am the first to discover that an air-condenser applied to a chemical telegraph will promote rapidity of operation at the receiving-instrument.

I claim as my invention—

1. The air-condenser inserted in the line at the receiving-station of a chemical telegraph, for the purposes set forth.

2. In a chemical telegraph, the method specified of forming dashes by transmitting, by means of perforated paper, a strong current followed by a weak current, substantially as set forth.

Signed by me this 19th day of January, A. D. 1875.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Stencil-Pen.

No. 196,747. Patented Nov. 6, 1877.

Fig. 1.

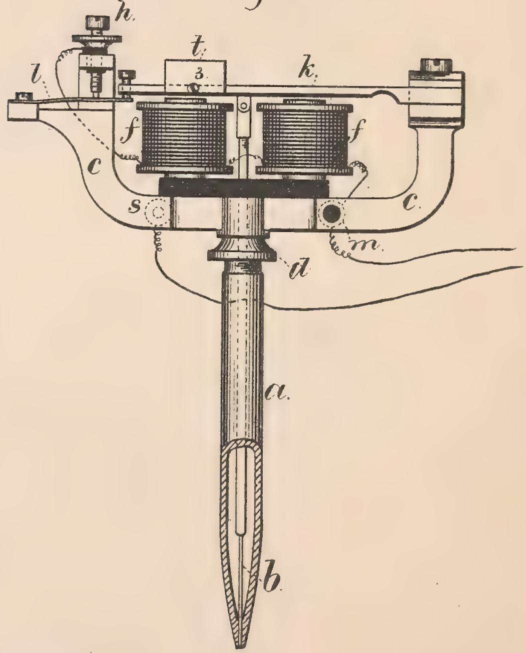
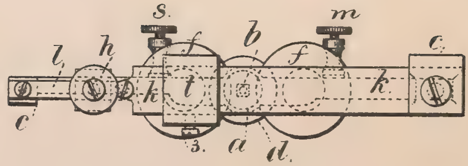


Fig. 2.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell
atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN STENCIL-PENS.

Specification forming part of Letters Patent No. **196,747**, dated November 6, 1877; application filed April 23, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Autographic Pens, of which the following is a specification:

My present invention relates to a pen actuated by electricity, and adapted to perforating paper that is to be used in printing in the manner set forth in Letters Patent No. 180,857, granted to me.

I reciprocate the perforating-needle with great rapidity by means of a reed or bar vibrating with great rapidity, and acting to open and close a circuit to an electro-magnet, that serves to maintain the vibration of the said reed or bar; and I employ an adjustable weight to vary the speed of vibration, similarly to a pendulum.

In the drawing, Figure 1 is a side view of the pen, reed, and magnet; and Fig. 2 is a plan of the same.

The tubular pen *a* and reciprocating needle *b* are similar to those in the aforesaid patent; and the tube *a* screws into the frame *c*, and it is clamped by the lock-nut *d* after the tube has been adjusted to the proper position relatively to the point of the needle.

Upon the frame *c* is an electro-magnet, *f*, the helix of which is connected at one end to the insulated adjusting-screw *h*, and at the other end to the insulated binding-screw *m*.

The reed *k* is secured at one end to the frame *c*, and the other end is free to act upon the spring *l*, and open and close the circuit between said spring *l* and the adjusting-screw *h*.

As the reed vibrates it opens and closes the circuit through the magnet. When the reed is attracted the circuit is broken, and as it flies back the circuit is again closed through the binder *m*, helix *f*, screw *h*, spring *l*, and frame to the binding-screw *s*, the flexible battery-wires being connected to these binding-screws *h* and *s*, as in aforesaid patent.

By this construction the speed of vibration will depend on the tone of the reed, and that may be altered and the vibration lessened or increased by moving the weight *t* along upon the reed and then clamping it by the screw 3.

When the weight is moved toward the point of attachment of the reed, the reed will be free to vibrate; but when moved toward the moving end of the reed the speed of motion will be lessened.

The upper end of the needle-rod is connected to this reed; hence motion of the reed is given to the rod and needle to actuate the same in perforating the paper.

The reed might be dispensed with, and a pivoted lever and spring be employed; but the speed and reliability are not as great as with the reed.

I claim as my invention—

The combination, with the electro-magnet and reed or lever vibrated by the same, of the perforating-needle, tubular pen, and circuit-breaker operated by the reed or lever, substantially as set forth.

Signed by me this 18th day of April, A. D. 1877.

THOS. A. EDISON.

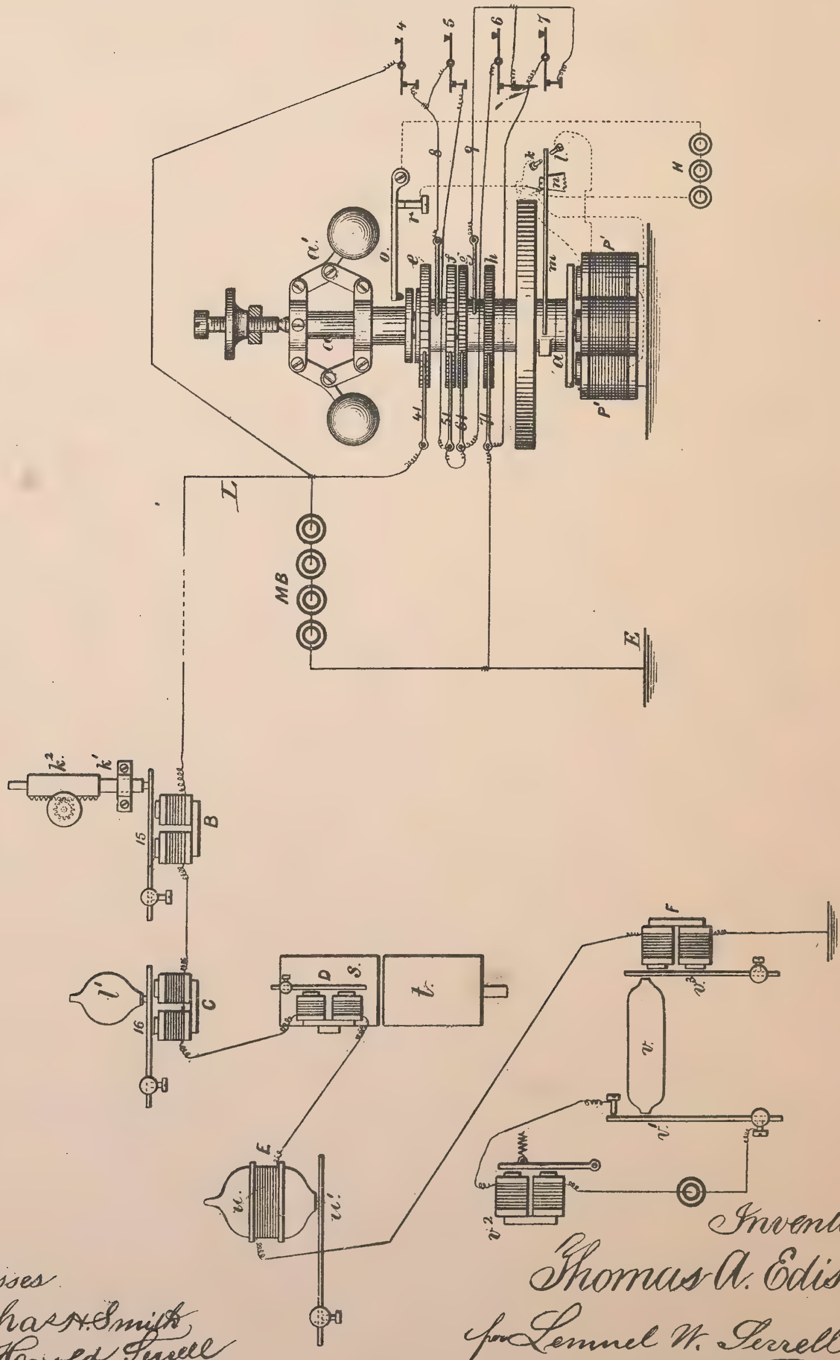
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Telephonic Telegraph.

No. 198,087. Patented Dec. 11, 1877.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
for Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,087**, dated December 11, 1877; application filed May 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

This invention relates to a series of revolving circuit-closing break-wheels with varying contact teeth and notches, so that each wheel produces a different number of pulsations per minute from the others, in combination with finger-keys and an arrangement of circuits in which the main battery remains in the circuit of the earth and line, and is caused to produce pulsations by being short-circuited through the break-wheels.

It also relates to an arrangement of finger-keys, in combination with the battery in the main line and the break-wheels, whereby, when all the keys are closed, the battery is short-circuited, and the revolving break-wheels are inefficient, and do not transmit waves over the wire; but when either key is opened the short circuit is made to pass through the articular break-wheel connected to the key, and the pulsations are transmitted over the main line; also to an electro-magnet, vibrating reed, and sounding-box or resonator of corresponding pitch, forming a receiving instrument; also, the combination therewith of a local circuit-breaking apparatus actuated by the vibrations of a column of air.

In the drawings, the improvement is shown by a diagram of the apparatus and the circuits.

The shaft *a* is driven by any desired power. I have shown the same as actuated by an electric engine, P′ P′, and battery H, and the lever *m* upon the standard *n* is moved by two cams upon the shaft *a*, and the spring end of the lever is between the circuit-closing points *k l*, the point *k* being connected in the circuit through one pair of magnets, and the point *l* being connected in the circuit through the other pair of magnets, so that the revolution is produced by the lever *m* closing the circuit through the electro-magnets alternately as the revolving armature is approaching the cores of such magnets.

The governor *a′* is upon and revolved by the shaft *a*, and *o* is a lever insulated from contact with the governor or shaft, but acting to close the circuit to the motor through contact-points *r*; hence the speed of the engine will be regulated accurately, for when the velocity increases sufficiently to separate *o* and *r*, the circuit to the engine will be broken and the reverse; hence the circuit will be closed through *o* and *r*, delicately, according to the speed.

The circuit closing or break wheels *e* and *f* are connected, and also *g* and *h*, but they are insulated from the shaft *a*; the circuit-closing springs 41 51 61 71 are provided for these wheels respectively, and they are connected to the finger-keys 4, 5, 6, and 7, respectively, and the conductors 8 and 9 are in contact with the respective pairs of break-wheels. The keys and break-wheels are in a short or derived circuit connecting from the line L to the earth E, to short-circuit the main battery.

Premising that the teeth of the respective break-wheels *e f g h* are at different distances, so that electric pulsations from each wheel will be different in number per minute from the pulsations of the other wheels, I remark that when all the keys 4 5 6 7 are closed the circuit from the line to earth is closed independent of the break-wheels *e f g h*; hence the battery M B will be short-circuited; but if the key 4 is opened the short circuit is only closed through 41, *e*, and 8; and hence the break-wheel *e* will alternately short-circuit the battery M B, and allow the same to charge the line, and there will be as many electric pulsations sent upon the line, at the speed of the circuit-breaker *e*, as there are contact-points passing while the key 4 is open.

If the key 5 is opened, the short circuit of the battery is, by 4 8 *f* 51 6 7, to earth, the break-wheel *f* and spring 51 giving the pulsations. If the key 6 is open, the circuit will be by 4 5 61 *g* 9 7, to earth, and the pulsations will be by the break-wheel *g* and spring 61. If the key 7 is open, the circuit will be by 4 5 6 9 *h* 71 to earth, the pulsations being by break-wheel *h* and spring 71.

By this arrangement each break-wheel is

brought into action by opening the corresponding key, and two or more break-wheels can be brought into action without either one preventing the action of the others, so that if all the keys should be opened simultaneously all the break will be operative, the short circuit being 41, *e*, *f*, 51, 61, *g*, *h*, and 71.

At the receiving-station, the main circuit from the line passes through the helices B C D E F of the respective electro-magnets, and in front of the magnets B and C are reeds 15 and 16, of a tone to vibrate by pulsations of the speed sent from two of the transmitting instruments. The reed 15 is in front of the telescopic-tube resonator, that is made of tubes k^1 k^2, one of which is movable by rack and pinion, or otherwise, so as to vary the length and quickly adjust the same to the tone of the reed or to the pitch required for the pulsations that are being sent. This allows for adjusting the reed itself, or for adjusting a vibrating body that is moved by the electro-magnet, whether the same is toned or not.

This sounding-box or resonator, being adjustable, accommodates the receiving-instrument to variations in the pulsations that may result from inaccuracy in the speed of the transmitting-instrument.

The reed 16, or its equivalent, is made with a valve at the mouth of the resonator l', so that the atmosphere therein will be vibrated by the corresponding pulsations acting in the electro-magnet, and from these resonators the signal may be ascertained by the ear applied to their small tubes.

The sounding-box *s* has upon it the magnet D and a reed or other vibrating body. The box is of such length as to respond to the vibrations of a certain pitch, and in front of the box *s* is a sounder-box, *t*, by which the column of air can be regulated and extraneous sounds kept from the box.

The Helmholz resonator *u* is made of a hollow iron shell, with fine wire wound around it, forming the helix E, through which the current passes.

The shell of the resonator becomes a magnetized core, and attracts the reed u', causing the same to vibrate in front of it, and by the expansion and contraction the air within is set in powerful vibration. The reed *u* may be made to operate a local circuit or to give the indication by sound.

The electro-magnet F, with a reed, v^3, toned to the proper pitch, is used in connection with the air-tube *v*, that is a resonator of the proper pitch corresponding to the reed.

A delicate contact-spring, v^1, is applied at the opposite open end to the reed v^3. It is preferably toned to the same pitch as the tube *v* and reed v^3, and vibrates by the action of the air in *v*.

The sounder v^2 is in a local circuit, of which the reed or spring v^1 forms a part; hence the sounder responds to the vibrations of the reed v^3.

I do not claim a series of wheels revolved by mechanism and transmitting pulsations corresponding in time to vibrations of an acoustic receiving-reed.

I claim as my invention—

1. A telegraphic circuit and battery, a series of revolving break-wheels, and a series of finger-keys, arranged in a derived circuit between the line and the earth, substantially as set forth, whereby the revolving break-wheels are short-circuited through the finger-keys, substantially as specified.

2. The combination, in a telegraph, of an electro-magnet, a sounding box or tube containing a column of air, and a reed acting as a valve at the mouth of the tube, so that the column of air is vibrated by pulsations in the electro-magnet, substantially as set forth.

3. An iron resonant tube or sphere, surrounded with a wire helix, and included in a telegraphic circuit, substantially as set forth.

4. The combination of an electro-magnet, vibrating reed, sounding-box or resonator of corresponding pitch, and a local circuit-breaking apparatus, actuated by the vibrations of a column of air in said resonator, substantially as set forth.

Signed by me this 9th day of May, 1876.

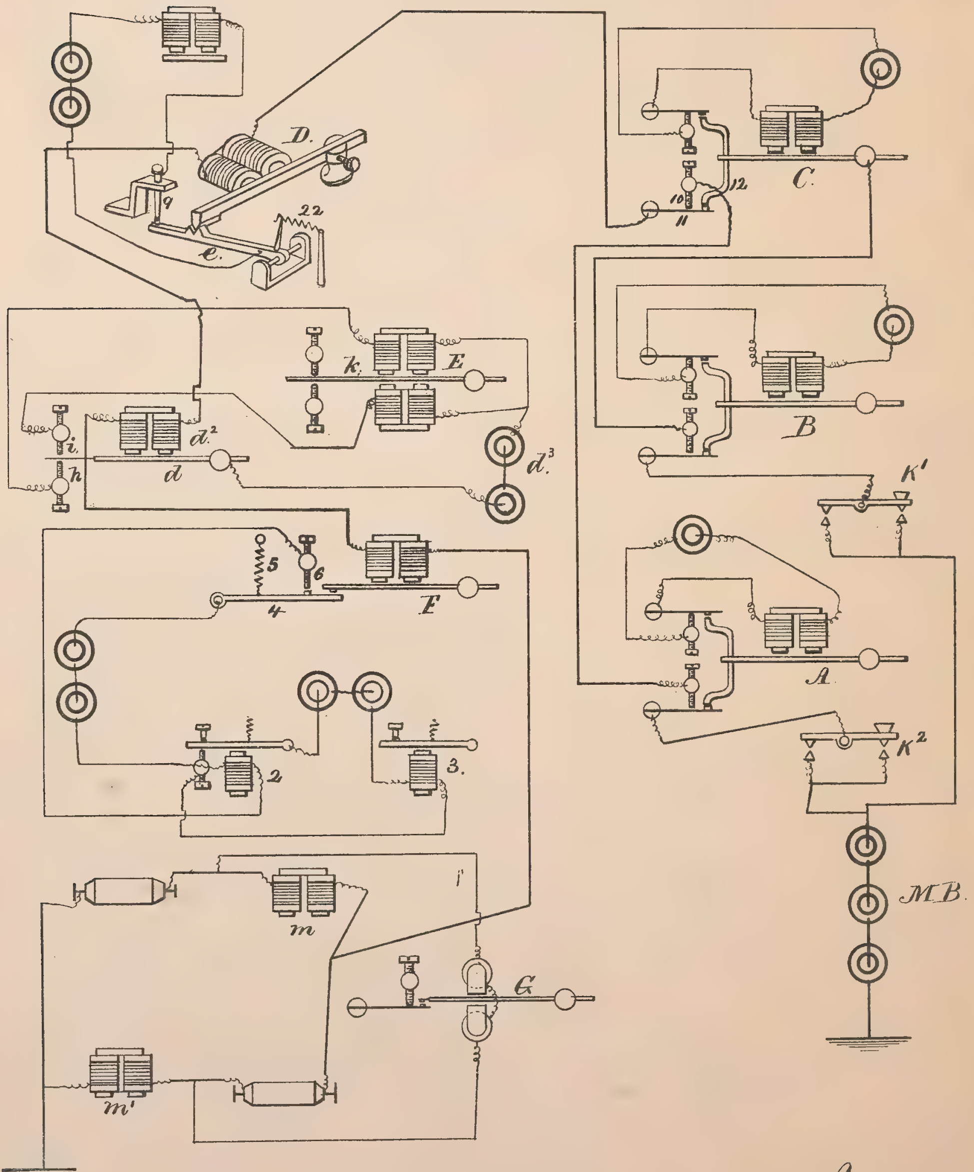
THOS. A. EDISON.

Witnesses:
J. D. RUSS,
CHAS. BATCHELOR.

T. A. EDISON.

Telephonic Telegraph.

No. 198,088. Patented Dec. 11, 1877



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,088**, dated December 11, 1877; application filed April 6, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

I make use of two or more reeds, vibrating automatically and continuously, preferably by a local-circuit electro-magnet and circuit-breaker operated by the reeds; and these are connected to a circuit-changer placed between them and the main line, and operating to allow the vibrations from only one of the reeds at a time to pass upon the line. This circuit-changer is operated with a speed much greater than that of either of the keys, but at a less speed than either of the transmitting-reeds, so that the pulsations from either of the reeds can be thrown upon the line by the finger-key; but the pulsations from two reeds will not be sent upon the line by the circuit-changer at the same time, so that the pulsations at the distant receiving-station will be more distinct.

A, B, and C are transmitting-reeds. The reed A is placed in one branch leading from the battery M B, while B is placed in another branch. The reed C is in the circuit from the instrument B, between that and the main line.

The reeds A and B transmit waves by just opening the circuit, while the reed C alternately throws the waves from B and A into the main line. Reed C makes but a few vibrations per minute, and it prevents the transmission of both series of waves over the wire at the same time. First, a series of waves is sent from A through 10 and 11; then A is disconnected by 10 and 11 being separated, and a series of waves are sent from B, through C, 12, and 11; but owing to the rapidity with which the two series of waves are alternated into the line by the vibration of the reed C, the break in the continuity of each series is scarcely felt on the receiving-reeds.

It is obvious that several branches might be used, in each of which is placed a reed of different vibrating times, and each reed transmitting waves by simply closing the circuit, (just the opposite to the reeds A and B, which open the circuit,) and a circuit-changing device, operated by C, made to throw in and out of the main circuit each reed in succession, thus preventing the transmitting of but one series of waves over the wire at the same time, and thereby preserving an even adjustment of the receiving-reeds.

It is not necessary that the reed C should always have a constancy of vibrating time, as it is used solely as a circuit-changer; hence an electric engine may be used, its shaft provided with a break-wheel and contact-points, whereby any number of vibrations or waves from different reeds may be allowed to pass into the line.

K^1 and K^2 are keys used for the purpose of signaling by allowing or preventing the transmission of the waves.

D is a receiving-reed actuated by an electro-magnet, and it is set in motion by waves coming over the wire periodic with its vibrating time.

The extreme end of the reed is provided with a beveled edge, passing into but not touching a V-recess in the local-circuit-closing lever *e*, which lever is provided with a platina point upon its end, which remains in contact with the screw 9, by the action of the spring 22, when the reed is not vibrating; but when the reed commences to vibrate, its beveled end strikes both sides of the V on the lever *c*, and keeps the lever from remaining in contact with 9 long enough to close the local circuit, in which I place a sounder and local battery, in the usual manner.

The object of the double V is to cause the lever to receive a great number of vibrations, and causing the local circuit to be broken a great number of times, thus allowing the use of reeds having a low rate of vibration.

The form of reed shown at E is adapted to vibrate by waves from one of the transmitting-instruments.

The sounder consists of a reed, instead of those constructed in the ordinary manner.

d is the main-line reed, operated by the magnet d^2 in the main-line circuit. *h* and *i* are two contact-points, one connected to one pair of magnets on the local reed K, and the other point to the other pair of magnets. The

other two ends of the magnets are joined together, and connected to a local battery, d^3, and thence to the reed d.

When no vibrations having a periodic time with d pass over the wire, both d and k remain quiet; but if the operator at the transmitting-station causes the proper waves to be sent, d is set in motion. This reed, making contacts on i and h, causes the reed k to vibrate very powerfully, and, hitting its two limiting-screws, makes a sound equal to that of an ordinary sounder.

The advantage of this form of reed is, that it may be worked on very long circuits, and does not require very fine adjustment.

F represents a receiving-reed adapted to the tone and number of vibrations of the transmitting-instruments, and there is a local circuit, in which the lever 4 is kept in contact with its contact-screw 6 by the spring 5 when the reed is not vibrating. This closes the circuit of the repeating-sounder 2, which, in its turn, closes the receiving-sounder 3, the object of the intermediate or repeating sounder being to intercept any false dots, and prevent slight closing of the local from affecting the receiving-sounder 3.

When the proper waves are sent the amplitude of the reed F is sufficient to practically keep the lever 4 away from 6, thus opening both sounders; but if the waves are made to cease, the lever 4 comes in contact with 6, and closes the locals, and indicates the signal given.

G is a polarized reed, provided with a circuit-breaker like F. The reed is permanently magnetized, either by a coil and local battery or in the usual manner, and is adjusted equidistant from the two prongs of the magnet.

When the current passes in one direction through the magnet, one prong has a magnetism the same as that of the reed; hence no attraction takes place, while the other prong will receive a magnetism the opposite that of the reed; hence it will be attracted. If, now, the current be reversed, the opposite action takes place, and the reed is attracted by the other prong. This polarized reed is placed in the bridge-wire of a Wheatstone bridge, formed of two branch wires, each containing a magnet and resistance-coil. When a wave comes over the wire, none of this current passes through the bridge-wire containing G, but, acting on m' and m, causes them to set up secondary currents, and these currents, being set up within the bridge-wires, are not in balance; hence they will flow through the bridge-wire and actuate the magnet of G.

The moment the main wave ceases a reverse current from the magnets m m' will be sent through the bridge-wire to G. The magnets m and m' may be replaced by secondary batteries or by shunted condensers, or other devices for generating secondary currents.

I claim as my invention—

1. The combination of several acoustic instruments, each transmitting a different series of waves or impulses, with an automatic circuit-changer, whereby but one series of waves is allowed to pass over the wire at the same time, for the purpose set forth.

2. The combination of an acoustic main-line receiving-instrument, operated by a series of waves within a main circuit of another acoustic instrument, corresponding in its vibrating time, within a local circuit operated by the main-line instrument, substantially as set forth.

3. The combination, with an acoustic receiving-instrument, of a repeating-sounder for intercepting false signals, substantially as set forth.

4. The reed d, vibrated by a magnet in the main-line circuit, in combination with the reed k, local circuit, magnets, and contact-points h i, substantially as set forth.

5. The combination of a polarized acoustic receiving-instrument in the bridge-wire of a Wheatstone balance with induction devices in the line, substantially as and for the purposes set forth.

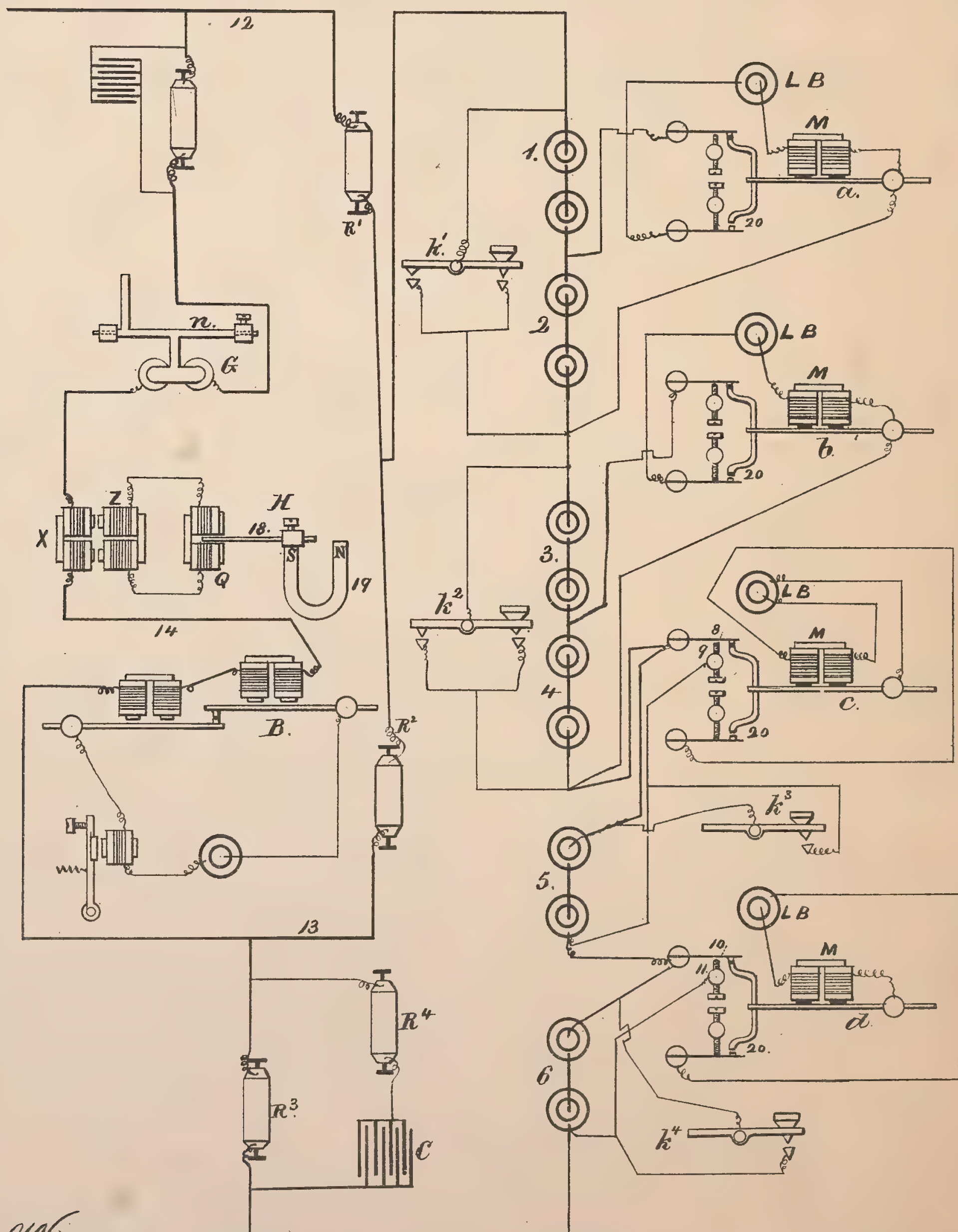
Signed by me this 3d day of April, A. D. 1876.

THOS. A. EDISON.

Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

T. A. EDISON.
Telephonic or Electro Harmonic Telegraphs.

No. 198,089. Patented Dec. 11, 1877



Witnesses.
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell Atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN TELEPHONIC OR ELECTRO-HARMONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **198,089**, dated December 11, 1877; application filed April 6, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification.

I make use of reeds vibrating in different periods of time. They are each kept in vibration automatically by a magnet and local circuit, and send pulsations corresponding in time upon the main line.

The batteries are each placed in the main line and arranged so as to oppose each other.

The receiving instruments are placed in the bridge of a Wheatstone bridge and balanced in relation to the outgoing current, and respond to the current from the distant station, and the receiving-instruments are peculiarly constructed, so as to respond to the transmitted pulsations.

a, *b*, *c*, and *d* are the transmitting-reeds, each having a different vibrating time, and L B are the local batteries, and M the electro-magnets in the circuits of the respective batteries, by means of which the reeds are vibrated automatically, the local circuit at 20 being broken by the movement of the reed toward the magnet.

1 and 2 are batteries opposed to each other. The battery 2 is short-circuited by the contact-points upon the reed *a* at every vibration, thus allowing the battery 1 to transmit a short wave over the main wire to the distant station.

K′ is a key, which only allows these waves to pass over the wire at the moment when its lever is passing from the back to the front contact-point, and in contact with neither. These short waves cause the receiving-reeds to open and close the sounder for a very short period of time, and allowing the signals to be read by the contact of the lever of the sounder upon its lower contact only.

3 and 4 are another set of batteries, operated in the same manner as 1 and 2, except that the reed *b* makes a different number of vibrations per second than *a*.

c and *d* are two other reeds, each of which serves to break a short circuit around the batteries 5 and 6, thus allowing the current from 5 or 6 to pass over the line at the moment that 8 and 9 or 10 and 11 are separated from each other and the signaling-keys K^3 and K^4 are open.

R′ R^2 and wires 12 and 13 form part of a Wheatstone balance.

14 is the bridge-wire, in which are placed the acoustic receiving-instruments G H B, operated by series of waves from the distant station. These reeds are in the bridge-wire, and the various resistance so adjusted that no currents from the batteries 1, 2, 3, 4, 5, and 6 pass through these instruments, but pass to the distant station to similar instruments in a bridge-wire of a Wheatstone balance.

R^3 is a resistance to balance the resistance of the line. R^4 is a resistance for increasing or decreasing the charging and discharging time of the equating-condenser C.

G is a receiving-instrument, which is worked by torsion.

n is a metal bar, preferably round, securely clamped to two upright pillars, and provided with two projecting arms, one for operating the local-circuit devices, the other to secure an armature placed over an electro-magnet, which, acting on this armature, twists the bar. The twist, length, or size of the bar varies its periodic vibrating time. Hence it is very quickly adjusted by twisting it to the right or left and tightening its clamping-screw.

X is a magnet placed in the main-line or bridge wire, with its cores facing those of a larger inductive magnet, Z, the wire upon which is connected to the magnet Q.

18 is a reed, polarized by the permanently-magnetized horseshoe-magnet 19. The passage of waves through X of one polarity causes positive and negative inductive currents to be thrown into Z and Q and causes the vibration of the reed 18.

B is a double-reed instrument, each of which is provided with an electro-magnet, and the extreme ends provided with contact-points. The reeds are tuned nearly alike, one being a little more flat than the other, so that its amplitude of vibration is not so great as the other. One part of the local circuit is connected to one reed, while the other part is connected to the other reed. This local circuit contains a battery and sounder.

When no waves periodic with the vibrating time of B are transmitted from the distant station the points on the extreme ends of the reed are not in contact and the local circuit is open; but if a proper series of waves is sent both reeds are set vibrating, and as one has a slightly-greater amplitude than the other they come in contact, close the local circuit, and vibrate together as long as the proper waves come over the wire.

I claim as my invention—

1. The combination, in an acoustic telegraph, of opposing batteries, a vibrating reed, and a short circuit to one of the batteries, opened and closed by the action of such reed, substantially as set forth.

2. In an acoustic-telegraph instrument, a torsion-rod, *n*, and an electro-magnet for vibrating the same, substantially as set forth.

3. The combination, in an acoustic-telegraph instrument, of two reeds, one having a slightly-different vibration from the other, and a local circuit to a sounder passing through such reeds, substantially as and for the purposes set forth.

Signed by me this 3d day of April, A. D. 1876.

THOS. A. EDISON.

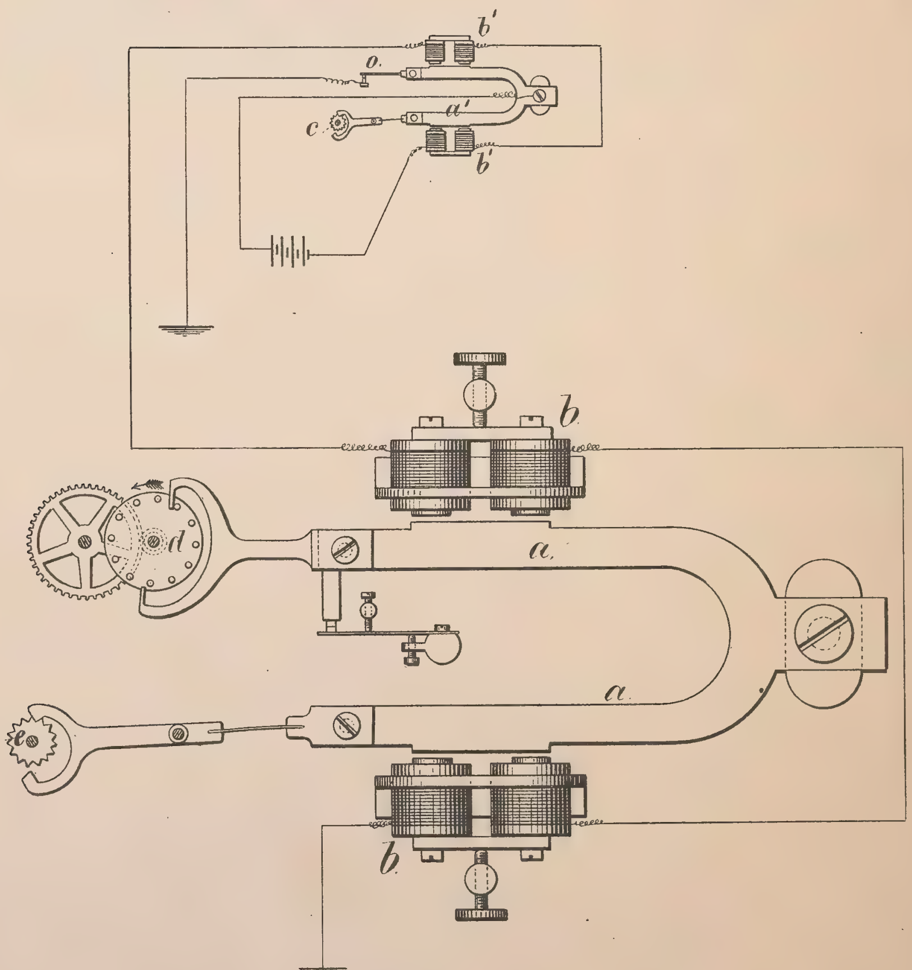
Witnesses:
HAROLD SERRELL,
CHAS. H. SMITH.

Case No. 126.

T. A. EDISON.

Synchronous Movements for Electric Telegraphs.

No. 200,032. **Patented Feb. 5, 1878.**



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor.

Thomas A. Edison.
per Lemuel W. Serrell
att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN SYNCHRONOUS MOVEMENTS FOR ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **200,032**, dated February 5, 1878; application filed November 1, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Synchronous Movements, of which the following is a specification:

The object of this invention is to produce the rotation of two or more shafts in perfect unison, whether they are near each other or more or less remote. This is available for controlling the movement of type-wheels in printing-telegraphs at distant stations, or for regulating the rotation of other mechanisms.

I make use of a reed or tuning-fork carefully tuned, and kept in vibration by the action of one or more electro-magnets; and in cases where the reeds or tuning-forks are in different places in the electric circuit the movement of one of such tuning-forks governs the electric pulsations passing to the others. This insures uniformity of vibration.

The electric circuits may be arranged in any desired known manner. Circuits of this character have been used by me.

In the drawing, *a a′* represent tuning-forks; *b b′*, the magnets for operating upon them to maintain the vibration, and *o* a circuit-opener to make and break the electric circuit in which the electro-magnets are placed. *c d e* are the shafts that are to be regulated in unison. There may be two or more of them.

Upon each shaft is a ratchet or escapement wheel, and upon the tuning-fork or reed is an arm carrying pallets or an escapement.

If a train of gearing and a weight or spring is used to revolve either of the shafts, the pallets will be shaped as an escapement to allow the wheel and shaft to rotate only at the speed resulting from the vibrations of the escapement by the reed or tuning-fork.

If the pallets are made wedge-acting, so as to move the wheel and shaft around by the vibration of the pallets, then the shaft may receive its revolving power from the reed itself.

Under any circumstances the speed of revolution will be the same in all the shafts if the number of teeth on the wheels is the same, or proportionate if the number of teeth is different, the vibrations of the pallets being in all instances the same.

I claim as my invention—

1. The combination, with a reed or tuning-fork, and an electro-magnet and circuit-breaker to maintain the vibration thereof, of pallets, a toothed wheel, and a shaft receiving its revolving motion from, or being controlled by, the vibrations of the reed or tuning-fork, substantially as set forth.

2. The combination of two or more reeds or tuning-forks, corresponding electro-magnets, and a circuit-breaker with two or more revolving shafts, toothed wheels, and pallets moved by the vibration of the reeds, substantially as and for the purposes set forth.

Signed by me this 30th day of October, A. D. 1876.

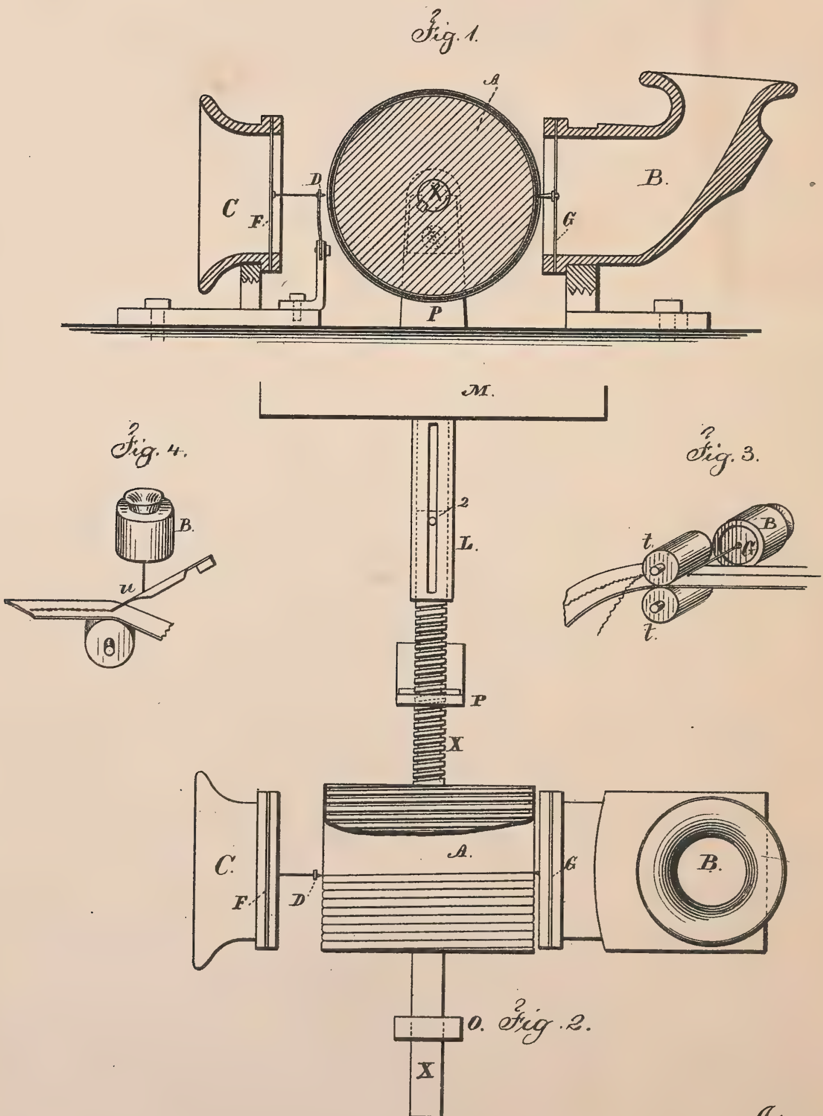
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.

Phonograph or Speaking Machine.

No. 200,521. Patented Feb. 19, 1878.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. **200,521**, dated February 19, 1878; application filed December 24, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, X, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L, the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall

exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the transmitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm G, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm, the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

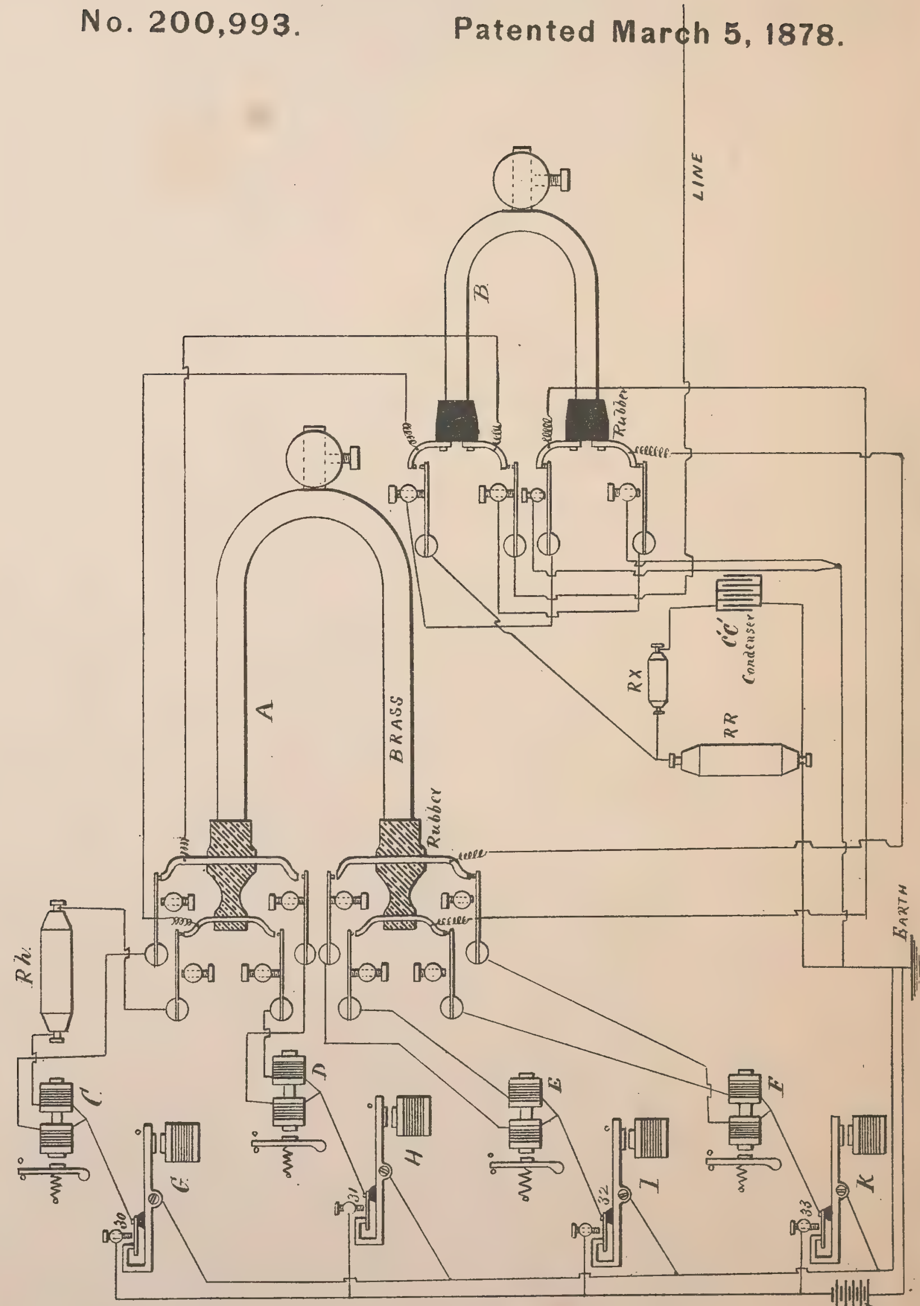
CHAS. H. SMITH.

2 Sheets—Sheet 1.

T. A. EDISON.

Acoustic Telegraph.

No. 200,993. Patented March 5, 1878.



Witnesses.
Chas H. Smith
Harold Serrell

Inventor.
Thomas A. Edison
per Lemuel W. Serrell atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

2 Sheets—Sheet 2.

T. A. EDISON.
Acoustic Telegraph.

No. 200,993. Patented March 5, 1878.

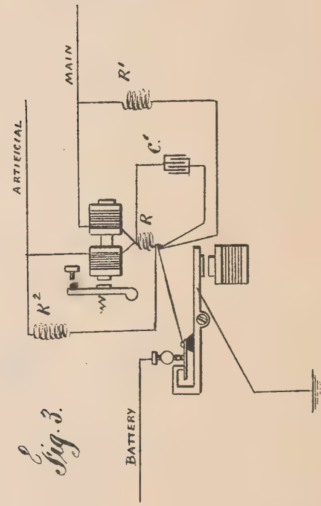


Fig. 3.

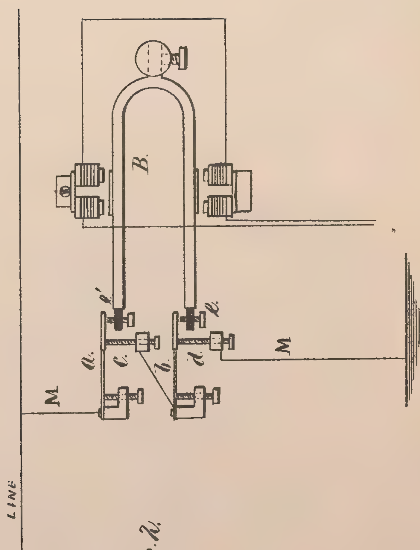


Fig. 2.

Witnesses.
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per Lemuel W. Serrell atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN ACOUSTIC TELEGRAPHS.

Specification forming part of Letters Patent No. **200,993**, dated March 5, 1878; application filed September 18, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Acoustic Telegraphs, of which the following is a specification:

The object of this invention is to transmit eight different messages at the same time over a single circuit without interference with one another.

The invention relates, primarily, to the method fully described in my application No. 122, by which one single circuit is transferred from one set of instruments at both ends of the line to several other sets, one after the other, alternately, thus creating four distinct signaling-circuits.

The present invention more particularly relates to a method by which each signaling-circuit so created can be again doubled by a manipulation of the currents, thus allowing of the transmission of four messages in one direction at the same time that four messages are sent in the opposite direction.

The diagram illustrates the connections at one terminal station only, the connection at the distant station being precisely the same.

A is the large transfer tuning-fork, making thirty vibrations per second, and kept in constant vibration by the interception of the local circuit, in which its magnets (not shown) are placed by the main-line tuning-fork upon the controlling-line, as in aforesaid application No. 122. B is another fork, placed in the same local circuit, but making double the number of vibrations of A—*i. e.*, sixty per second.

The method by which these local tuning-forks at both terminals are kept in accurate unison is fully described in my aforesaid application, and the contact-points, instruments, and connections are arranged exactly as shown in that application, excepting that both A and B are provided with an extra set of springs, and the receiving-magnets with extra coils, and to which extra springs, connections, and coils is attached an artificial line of about the same resistance and of about the same electro-static capacity as that of the real line, so that when the line is being transferred from one set of instruments to the other the artificial line is at the same time transferred to the same instruments, which object is attained by causing the relay-magnets to have two sets of coils, one through which the main-line current passes in one direction, while through the other the current of the artificial line passes in the opposite direction. The latter, when its resistance is properly adjusted, allows of the transmission of current through the signaling-relays to the distant station without affecting such relays, which are free to receive the message from the distant station, and the same action takes place on all the instruments at both terminals.

C, D, E, and F are the double-coil relays, C being connected to the spring 30 of the transmitter G, D to 31 of H, E to 32 of I, and F to 33 of K, the levers of all of the transmitters being connected to earth.

Immediately over these springs are contact-points connected to the main battery. Either spring is brought in contact with its contact-point upon closing the key (not shown) of a local circuit, in which the electro-magnet of the transmitter is placed. At the same time that the point comes in contact with the spring it separates the spring from the earth-wire. This puts the battery in connection with the double spool of the relay. At the moment when the main line is connected at both ends by the vibration of the forks the current from the battery passes through one of the coils to the distant station, and would tend to close the relay; but at the same time the battery-current passes through the other coil (in an opposite direction) over the artificial line; and as the resistance of that is such that the current strength in each coil is the same, but the tendency opposite, and as the static charge and discharge are the same on both, the relay remains unaffected, and is ready to receive signals from the distant station. The high fork B serves to split the main line into two parts, and also the artificial line into two parts, allowing both the main line and the artificial line to remain in contact with the earth for a short period of time after it has been connected to one split, and disconnecting it from the earth just before it is placed in contact with the other split. R R is the resistance-coil, which serves to create the artificial line. *c′ c′*

is the condenser, which serves to give the artificial line the proper electro-static capacity. while $R^{\times}$ is an adjustable resistance, which serves to increase or decrease the discharging time of the condenser to meet the various discharging times of different circuits.

R *h* is a resistance-box, which, in practice, I shall probably insert in each of the splits passing to the artificial line, for the purpose of obtaining a more perfect balance of the two circuits, as it has been found difficult to construct differential magnets so that all coils shall produce the same amount of magnetism in their cores.

In addition to the apparatus shown, I propose to insert a fork or forks making the same number of vibrations as B at various stations along the line, and keep them in motion by acoustic relays in the controlling-line, passing through the same stations, and arranging the contact-points as shown in Fig. 2, for the purpose of discharging the wire between each wave or vibration, which will enable me to work very long circuits. A shunt, *m*, passes to the spring *a*, and connects it to earth, (and at that particular period of time when neither prong is in contact with *a* or *b*.) The spring *a* rests upon *c*, and is connected to *b*, thence through *d* to earth; but when the fork is a little over the center of point of rest, either on one side or the other, the continuity of the earth-connection is interrupted either by the separation of *a* from *c*, or *b* from *d*.

This action of putting the line to earth outside of the instruments between each vibration takes place, or may take place, at both terminals, and at any number of way-stations.

On very long lines more perfect signaling is attained by connecting the receiving-instrument as in Fig. 3.

R is a large resistance, shunted with a condenser, c'. R^1 and R^2 are two smaller resistances in shunts to lessen the total resistance of the circuit, and to provide a circuit for the discharge of the condenser-current, which, by its action upon the relay, serves to neutralize, to some extent, the static discharge from the line due to the passage of the distant signaling-current.

I do not wish to confine myself to any particular relay, or the use of single currents, as polarized relays and reversed circuits may be used; neither do I wish to confine myself to the use of differential-coil relays for balancing the outgoing current, as the whole arrangement may be placed in a Wheatstone bridge, and which will be the subject of another application; neither do I wish to confine myself to the transmission of eight messages, as each of the four circuits (obtained by the rapid transfer of the line upon the several instruments) can be split up again by employing another set of higher and lower forks, and each of the eight circuits so obtained can be doubled in the same manner as those already described by a mere duplication of springs and points; or, instead of splitting the wire up into eight wires, it can remain as in this application, and each of the four splits may contain two signaling-instruments, one responding to positive and negative currents independent of their tension, and the other to strong and weak currents independent of their polarity, the connection being made to each split in the same manner as they would if such split were an actual wire.

Upon reference to my aforesaid application No. 122, it will be understood that the forks B vibrate exactly in time with each other at the two ends of the line, that the forks A also vibrate in time with each other at the two ends of the line, but at half the speed of the forks B.

In the vibrations of a musical fork, the prongs both move away from each other, and then both move toward each other, and this feature and the synchronous movements cause the circuit-closers to be operated exactly in harmony, so that when the key G is operated the circuit from the battery, which is thereby closed, will only reach the corresponding receiving-instrument at the distant station, and so on of all the other signaling-instruments, the circuits being simultaneously opened and closed to each instrument at both ends of the line at each vibration of the fork, and also closed to the artificial line, and all the circuit-closers are similar to circuit-preserving keys, so that the circuit is not entirely broken at any time.

I claim as my invention—

1. In a transmitting telegraph-instrument, two tuning-forks, extra contact-points, and circuit-connections to the main and artificial lines, substantially as and for the purposes set forth.

2. The combination, with the several tuning-forks or equivalents composing the transferring mechanism, of a main line and an artificial line with devices connected to the latter to create proper conditions, and receiving-instruments, for the purpose set forth.

3. The combination of several continuity-preserving transmitting-instruments, differential-coil relays, resistance-coils, and condensers, substantially as shown, with the vibrating tuning-forks, or equivalent devices, at both terminals, with the main line and artificial line, for the purposes set forth.

4. The tuning-fork B, Fig. 2, spring *a b*, points *c d*, and line and earth wire *m*, all arranged and operated substantially as set forth, and for the purposes specified.

5. The shunts R^1 and R^2, Fig. 3, resistance R, condenser c', in combination with the electro-magnet or other receiving-instrument, for the purposes set forth.

Signed by me this 26th day of August, A. D. 1876.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

GEO. D. WALKER.

T. A. EDISON.

Automatic Telegraph Perforator and Transmitter.

No. 200,994. Patented March 5, 1878.

Fig. 1.

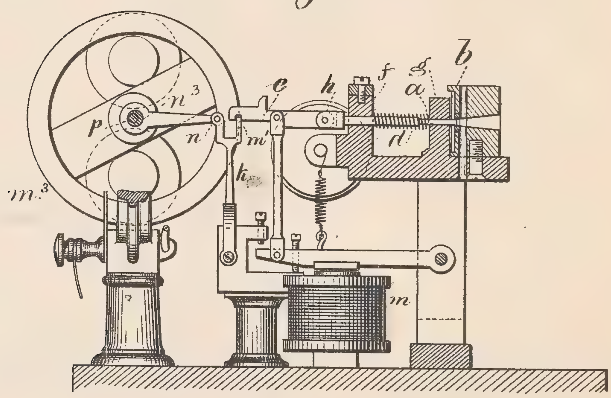
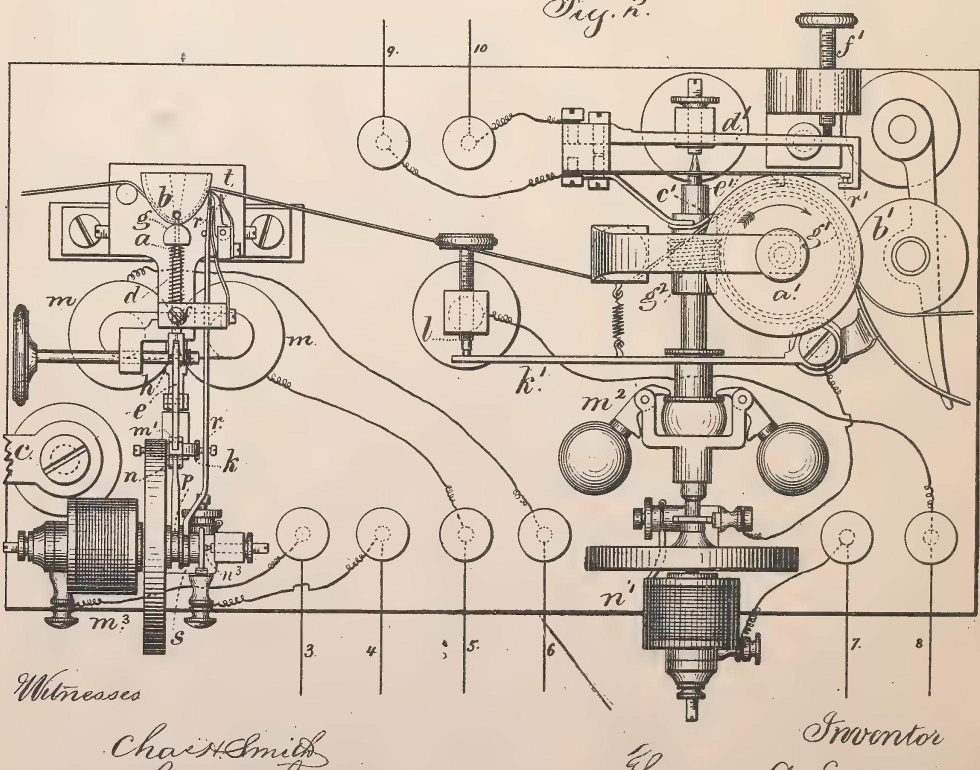


Fig. 2.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

pers Lemuel W. Serrell Atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC-TELEGRAPH PERFORATOR AND TRANSMITTER.

Specification forming part of Letters Patent No. **200,994**, dated March 5, 1878; application filed November 11, 1876.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

The object of this invention is to transmit Morse characters over a local circuit or telegraph-line by any of the usual methods, and record the same simultaneously and automatically by perforating a strip of paper, which strip, so perforated, serves to retransmit the same message over other circuits or lines.

By this improvement a record of the message can be made at the transmitting or receiving station, or at any intermediate station, by the perforated paper, without obstructing the operation of the line, and that strip can be used for subsequent automatic transmission.

I make use of a shaft revolved, preferably, by an electric engine, and operating a paper-feed and a punch, the feed taking place when the punch is out of the paper, and there is a coupler between the power and the punch for connecting or disconnecting the latter, which coupler is operated by an electro-magnet, so that the message, passing through the magnet, will be effective in operating the perforator, and the perforated strip serves as a record, or it can be used for retransmission.

The invention further consists in the mechanism for retransmitting the message from the perforated strip.

In the drawing, Figure 1 is a sectional elevation of the punching mechanism, and Fig. 2 is a plan of the complete apparatus.

a is the punch. *b* is the die between which the paper passes from the roll upon the arm *c*. *d* is the spiral spring which aids in withdrawing the punch from the paper. The bearings of the punch are *f* and *g*. *e* is a coupler, secured to the punch at *h*, and provided with a notch at its extreme end. The coupler is moved up and down by the lever of the magnet *m*.

k is a pivoted lever, provided with two prongs at its end, one of which, m^1, catches in the notch on *e* when the lever of the magnet is attracted, thus connecting the coupler *e* to m^1. The other prong of *k* is connected by the link and joint *n* to the eccentric *p* upon the engine-shaft n^3. *r* is the paper-feeding lever, also connected to the engine-shaft by an eccentric, *s*.

The eccentric *p* is set at one hundred and eighty degrees, or nearly so, to the eccentric *s*, so that the punch enters the paper while the feed-lever is drawing back, and the punch comes out of the paper just as the feed-lever commences to move the paper forward, thus producing an accurate timing of the punching and feeding devices.

The electric engine m^3, for actuating the punch and paper-feed, is in the circuit 3 4 of a local battery.

The feed-lever *r* is provided with points, which engage with the paper and allow it to be carried forward. *t* is a click, which prevents the paper from receding when *r* is drawn back.

The operation is as follows: When the circuit in which the magnet *m* is placed is open, the coupler *e* is thrown upward, and the punch remains out of the paper, and receives no movement; but the paper-feed *r* continues to move the paper forward at a regular rate. If, now, the circuit in which *m* is placed is closed, the magnet becomes energized, its lever is attracted, and the coupler *e* is brought down upon the prong m^1, locked to it, and immediately the punch reciprocates rapidly, passes through and out of the paper. The first movement punches a hole the same size as the punch, but thereafter, and so long as the magnet *m* is closed, punches only crescent-shaped pieces at each movement, as the paper-feed is only a fraction of the distance covered by the punch; hence an elongated slot or perforation is made, its length depending upon the length of time that *m* is energized. Immediately that the circuit containing *m* is broken, the coupler *e* is thrown out of contact with m^1, the punch ceases to be reciprocated, while the lever *r* continues to feed the paper, thus forming the spaces.

As the engine-shaft n^3 makes several thousand revolutions per minute, the perforated characters can be formed with great rapidity.

The electro-magnet *m* is in a circut, 5 6, to a distant station, in which circuit there is a

receiving-instrument, battery, and finger-key, and the message transmitted to said distant instrument corresponds to the message perforated in the strip of paper by the punch *a*. After the strip has been punched it is passed through the transmitting or translating machine, which consists of a drum, *a'*, provided with a slot around its whole circumference, and in its center.

b' is the roller for pressing the paper against the drum, so that it may be carried forward. *c'* is a forked spring, used for holding the paper against the drum, and also to gripe the end of the paper as its end is passed between the spring and the drum. g^1 is a pinion-wheel, engaging with a worm, g^2, upon the shaft of the electric engine n^1, and said engine is in a circuit, 7 8, of a local battery. m^2 is a governor, which, as the speed increases, causes the lever *k'* to be withdrawn from *l*, thus breaking the circuit in which the engine is placed.

By the use of the worm and pinion a very even rotation of the drum *a'* is attained, while allowing great rapidity of rotation of the electric engine, which is desirable, and by the use of the electric governor any required speed is easily attained. The circuit-breaking devices consist of a duplex spring, *e' d'*, and the wires 9 10, connecting with *e' d'*, form part of the circuit to a distant station, to which the message is to be retransmitted. *e'* is provided with a V-point somewhat smaller than the slot in the periphery of the drum *a*. This point is in line with the perforated characters, and when resting on the paper the extreme end of *e'*, which is tipped with platina, is separated from the point *r'* of *d'*; but when a perforation passes under the point on *e'*, the said point enters into the slot in the drum, bringing the end of *e'* in contact with *r*, closing the circuit, which is again broken the moment the paper intervenes between the point of *e'* and the drum. *f'* is a screw for adjusting the contact-points to or from the drum *a*.

I will mention that the electric engines might be displaced, both in the puncher and in the transmitter, by clock-work, or by tuning forks or reeds set in motion by electro-magnets—in the case of the puncher one prong serving to actuate the punch, while the other prong would actuate the paper-feed, and in the case of the transmitter the tuning-fork could, by a suitable toothed wheel and click, give practically a continuous rotation to the drum, the speed being regulated by movable weights on the prongs of the fork, or by double pressure-springs.

I will also mention that if the puncher is to be used merely for preparing the paper for transmission, the locking-coupler *e'* might be actuated by a movement derived from a Morse key, without the use of electricity; and where great speed is required in perforating, the shaft upon which the eccentrics are placed might be rotated by hand, a small pulley being secured to the shaft, which would be connected to a very large one by a belt or geared by toothed wheels, and the whole set in motion by hand or foot power.

I will also mention that an absolute lock like the lever *e* and prong m^1 is not absolutely requisite when considerable power is used to revolve the eccentrics, for if plenty of power is used, as with hand-power, the spiral spring *d* around the punch can be strengthened and made to draw the punch out without aid from the eccentric-lever, and the mere insertion of a wedge between the end of m^1 and a continuation of the punch *a* will serve to actuate the punch. Such wedge is free to be withdrawn at each revolution of the shaft carrying the eccentric, and there is but little movement; hence a very weak power will suffice to throw the wedge in and out.

I will also mention that the punch and paper-feeding mechanism may be reciprocated continuously, and the characters formed by using a movable die and paper-feeding wheel, both of which can be brought toward the punch and feed-click by an electro-magnet, or by hand. It is not even essential that the paper-feed click should impinge directly upon the paper, as the paper may be passed over a drum and the drum rotated by the feed-click engaging in the teeth of a ratchet-wheel upon the shaft of the same.

I will also mention that when it is required that reverse currents should be used, so as to enable the punching mechanism to be controlled by a polarized relay whose lever operates the magnet *m*, two punches may be used, one under the other, but separated, say, one-thirty-second of an inch, and the locking mechanism so arranged that when *m* is closed the top punch will enter the paper, and when open the eccentric will be locked to the other punch when it enters the paper, thus causing the spaces between the characters in the upper row to have perforations immediately below them in the second row. In this case the transmitting-drum is to be provided with two grooves and two contact-springs, one connected to the positive pole of a battery, while the other is connected to the negative pole of another battery, thus allowing the transmission of alternate currents. Even one battery could be used and the springs arranged to reverse the same.

I claim as my invention—

1. The punch and die *a b* and notched coupler *e*, in combination with the eccentric *p*, fork *k*, and electro-magnet *m*, substantially as set forth.

2. In a perforating apparatus, a continuously-revolving shaft and a step-by-step feed, operated thereby, in combination with a punch that is actuated by the shaft while the paper is quiescent, a coupler to connect the power and the punch, and an electro-magnet to move such coupler, substantially as set forth.

3. Punch and paper-feeding mechanism re-

ciprocated by the eccentrics *p* and *s*, when the same are arranged in such a position that the paper is only fed when the punch is clear of the die.

4. The transmitter consisting of a drum, *a′*, contact-points and springs *e′ d′ r′*, electric engine n^1, and governor m^2 *k′ l*, all arranged and operated substantially as specified, and for the purposes set forth.

Signed by me this 30th day of October, A. D. 1876.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Speaking Machine.

No. 201,760. Patented March 26, 1878.

Fig. 1.

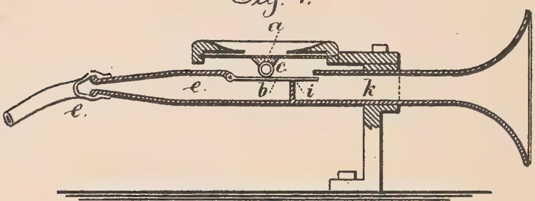


Fig. 2.

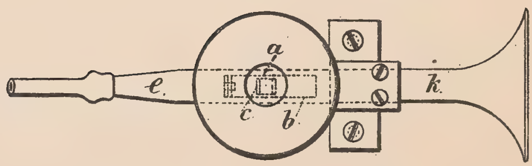
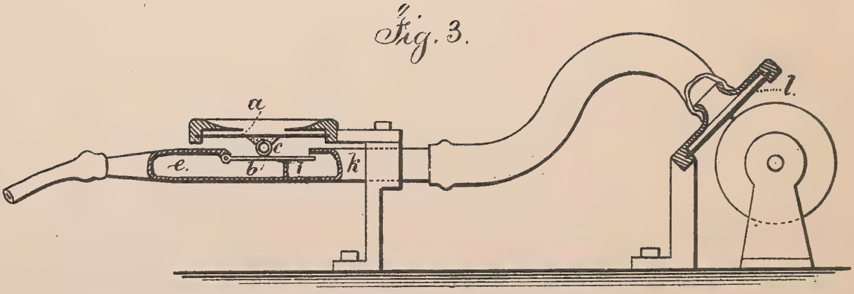


Fig. 3.



Case 153.

Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thos. A. Edison.

per Lemuel W. Serrell atty.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN SPEAKING-MACHINES.

Specification forming part of Letters Patent No. **201,760**, dated March 26, 1878; application filed March 4, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Machines, (Case 153,) which I term the "Aerophone," and of which the following is a specification.

The object of this invention is to reproduce the human voice or other sounds with greatly-increased volume or force.

Articulation produces certain atmospheric sound waves or vibrations in a given relation to each other in respect to volume or character. The sound-waves of words uttered in a whisper correspond generally to those uttered in the loudest tones, except in the volume.

In my phonograph, heretofore secured by me, (Case No. 149,) the sound produced by the instrument corresponds to the sound acting upon the diaphragm, only less in volume.

The object of the present invention is to reverse the action of the phonograph, and cause the human voice or other source of sound to reproduce that sound in tones that are louder than the original utterances, thereby enabling a feeble voice to be heard distinctly to any desired extent within the capacity of the instrument.

I make use of a diaphragm, against which the sound-vibrations are directed from the voice or other primary source of sound, and this diaphragm or other body moved by such sound-vibrations is made to control the exit of air, steam, or other fluid under pressure, and so set in motion secondary sound-vibrations, the same as the primary sound-vibrations, except of greater volume. The relative volumes of the sound-vibrations will depend upon the pressure of the fluid and the opening for the escape of the same.

My invention is available for giving orders upon vessels, for signaling distant vessels, for military orders, for orders at fires, for communicating between engineers of passing locomotives, for station-signals, and for addressing large assemblies, or for giving audible utterances that are sufficiently powerful to be heard above surrounding noise or confusion.

In the drawings, Figure 1 is a section. Fig. 2 is a plan of the instrument as adapted to an organ-pipe or trumpet for direct action in increasing the volume of the sound; and Fig. 3 is a section of the instrument in connection with a phonograph, for increasing the amplitude of the vibration that makes the record.

The diaphragm *a* is acted upon by the human voice or other sound, and vibrated by the same. By the term "diaphragm" I mean any body capable of and adapted to respond to atmospheric sound-vibrations, so that the said vibrations shall be given to the diaphragm or its equivalent.

I make use of the vibrations of the diaphragm to operate a valve, *b*, that is connected with the diaphragm *a*, preferably by a section, *c*, of india-rubber tubing. The diaphragm is to be inclosed in a proper case, that directs the sound upon the diaphragm, and the valve is, by preference, balanced by being pivoted in the center, so that the pressure of the air, steam, or gas upon the valve does not interfere with its movement.

The air, gas, steam, or other fluid under pressure, is supplied from a suitable holder by the pipe *e*, and at *i* the valve allows or checks the escape of the said fluid into the pipe *k*. If the valve is covered with a sheet of india-rubber, secured at its edges and to the tubes *e* and *k*, leakage will be prevented, but the valve will be free to be moved by the diaphragm.

It will now be apparent that the valve will open more or less at *i*, according to the amplitude of vibration of the diaphragm, and hence that the air passing at this point will be a multiple of the sound-vibrations of the atmosphere acting upon the diaphragm; hence corresponding tones will issue from the tube or trumpet *k*, and by increasing the pressure of the fluid, so the volume of sound will be increased. My experiments and tests lead me to believe the apparatus capable of very great increase of the secondary sound over and above the primary controlling sound; and I remark that the apparatus employed may also be greatly varied, according to the object to be attained. Care is required to prevent interference with the clearness of the articulated sounds, in consequence of any musical resonance in any of the parts of the apparatus.

In Fig. 3 the parts before described are represented as combined with a receiving-diaphragm, *l*, that actuates a recording-point to record the sound-vibrations, as in my aforesaid phonograph. In this case the indentations

will be much greater, on account of the amplitude of the vibrations given to the disk.

It will be evident that the phonographic record may be employed instead of the diaphragm to operate the valve *b*, and thus allow the record to be made of the articulations, after which such articulations are reproduced in the same or in increased volume as the original utterances.

I claim as my invention—

1. The combination, with a diaphragm, or the record produced therefrom, of a valve and a supply of air, gas, steam, or other fluid under pressure, for reproducing sounds, substantially as set forth.

2. The method herein specified of producing sound, by causing primary sounds or articulations to act upon a diaphragm, and then controlling the exit of a fluid under pressure in harmony with the primary sounds, to produce secondary sounds corresponding with the primary sounds, but of different volume, substantially as set forth.

Signed by me this 28th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Speaking-Telegraph.

No. 203,013. Patented April 30, 1878.

Fig. 1.

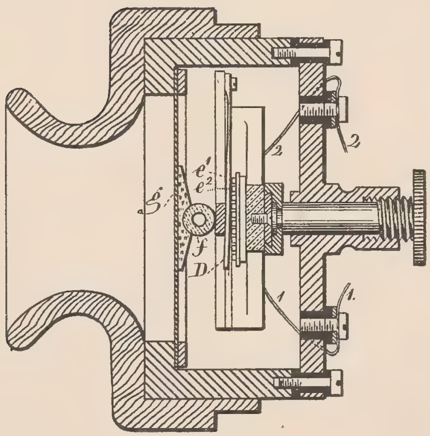


Fig. 2.

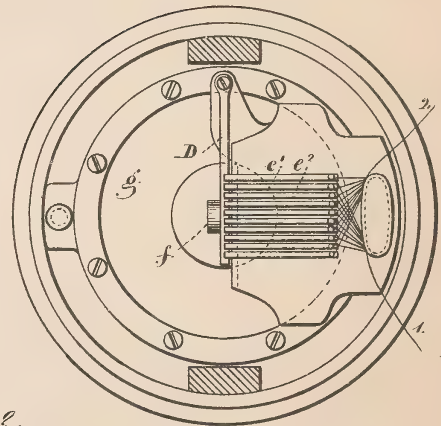


Fig. 3.

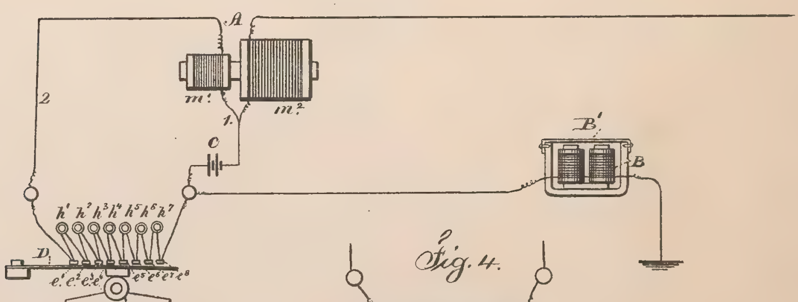


Fig. 4.

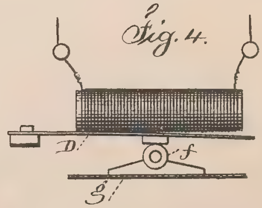


Fig. 5.

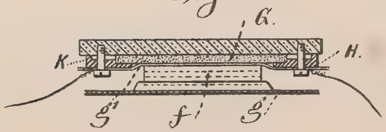
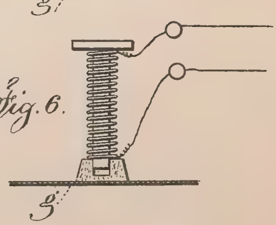


Fig. 6.



Witnesses

Chas H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,013**, dated April 30, 1878; application filed December 13, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

The object of this invention is to transmit and receive oral communications over telegraphic circuits.

This telegraph is operated by sound vibrations. I make use of a rheostat with numerous contact-points, and a conductor that is operated by the sound-vibrations, and serves to short-circuit the rheostat to a greater or less extent, according to the amplitude of vibration. I interpose an elastic cushion between the conductor and the diaphragm or other body moved by sound, to prevent false vibrations, and I employ an induction-coil and a local circuit, arranged in such a manner that with a weak local battery the line-current is augmented, and the rise and fall of electric tension is in proportion to the sound-vibrations.

Figure 1 is a section of the instrument for transmitting; and Fig. 2 is a view at the rear of the diaphragm, showing the manner of winding the rheostat-wires. Fig. 3 shows the diagram of connections for one terminal station.

A is an induction-coil, consisting of one bar of iron and two coils, m^1 and m^2, the latter being placed in the main line, in which the local battery c and the receiver B also forms a part.

m^1 is the primary inductive magnet, of very low resistance, placed in a local circuit, 1 2, containing also the rheostat or resistance-coils h^1 h^2 h^3 h^4, &c.

e^1 e^2 e^3 e^4, &c., are springs, each one being connected to the juncture between each resistance-coil. These springs e^1 e^2, &c., are contiguous to the spring D, and when the spring D is moved it comes in contact with e^1 just a little before it does with e^2, and so on. When e^1 and e^2 are in contact with D the resistance h^1 is cut out of circuit, and if e^2 and e^3 are in contact with D the resistance h^2 is cut out, and so on, and contact between all the springs and D cuts all the resistance out of circuit. For very powerful effects the resistance of m^1 should be less than one ohm, and the total resistance of h^1 h^2, &c., about five ohms. Then the slightest movement of the spring D, when properly adjusted, will cause a great rise and fall in the strength of the magnetism in the core of m^1, and a consequent powerful induced current will pass over the line and set the plate of the receiver at the distant station in vibration.

If the diaphragm g is set in powerful vibration, a greater number of springs e e^1, &c., come in contact with D, and a greater disturbance of the magnetism of the core of m^1 takes place, transmitting a more powerful wave into the main line, which is in one direction when the diaphragm causes D to approach the springs, and in the contrary direction when it recedes therefrom, thus the strength of the waves sent into the main line are proportionate to the amplitude of vibration of the diaphragm.

I do not wish to confine myself to any particular arrangement of the springs e^1 e^2 e^3, &c., as they may be arranged to radiate from a center, like a sunflower, around a metallic disk, beveled in the proper manner, and secured to the diaphragm, so as to come in contact with one after the other of the springs as the diaphragm approaches. It is not even necessary that the springs should be worked in a local circuit, as the resistance between each spring may be greatly increased, and the transmitter inserted directly in the main line with the receiver and battery.

Fig. 4 is a modification of the rheostat. The same consists of a cylinder of insulating material, having a thread cut in it from end to end, and containing wound very fine platina wire, the total resistance of which may be five ohms. The forward movement of the diaphragm g causes the spring d to short-circuit each convolution of the wire, one after the other, and thus decrease the resistance of the local circuit.

In Fig. 5 the wire resistance is replaced by a semi-conductor, such as plumbago, at G, included in the local circuit, the connections being made by the metallic clamps K and H. f is a piece of rubber tube fastened to the diaphragm, and faced with a thin piece of platina foil, g', which acts in the same manner as the spring D in Figs. 2, 3, and 4. The forward

movement of the diaphragm causes more and more platina to come in contact with the plumbago, thus allowing a greater part of the current to pass through the platina, according to the amplitude of the diaphragm-vibrations. Of course, other materials, such as silicon, boron, sulphides of the heavy metal, and other conducting chemical compounds, may be used; or even very thin strips of gold, platina, silver, and other metals may be used in the same manner as the plumbago. In Fig. 6 the change in the resistance of the coil of wire takes place longitudinally, a spiral of insulated wires being arranged on a stud of insulating material, and compressed or allowed to expand by the movement of the diaphragm, thus causing the various convolutions to short-circuit one another.

By this construction of apparatus and arrangement of circuits I am enabled to transmit upon the line electric undulations proportionate to the length of line, so as to produce the proper response at the distant receiving-magnet B and diaphragm-armature B′, because the rheostat will cause more or less resistance in the local circuit, and the polarity of m^2 will alternate with the rise and fall of the electric tension in the local circuit, and the battery *c*, also being in the main line, will act to neutralize or augment the main-line current, according to the polarity of that current, and in proportion to the resistance of the local and main-line circuits, thus obtaining a powerful current on the line from a weak local current.

The elastic cushion *f*, interposing between the diaphragm or other article vibrated by the atmospheric sound-waves and the short-circuiting conductor of the rheostat, prevents any musical vibrations of either D or *g*, and causes a gentle yielding movement and change of electric tension in proportion to the sound without risk of false vibrations.

I do not claim herein the disk of plumbago G, (shown in Fig. 5,) as this is similar to that shown in my application No. 130; neither do I herein claim the sheet-iron diaphragm forming an armature to the electro-magnet, as that is shown in some of my former applications, and the resistance to the electric circuit is also varied by the motion of the diaphragm in said application No. 130; therefore the same is not claimed herein.

I claim as my invention—

1. In a speaking-telegraph, the combination, with a diaphragm, of a rheostat or resistance-coils and a conductor vibrated by the diaphragm, and acting to short-circuit more or less of the rheostat in proportion to the amplitude of the vibrations, substantially as set forth.

2. In combination with a diaphragm actuated by sound-vibrations and a metallic conductor, an elastic cushion, *f*, interposed between the diaphragm and said metallic conductor, to move the latter in proportion to the movement of the diaphragm, substantially as set forth.

3. In a speaking-telegraph, the combination, with the diaphragm and rheostat, of a local circuit and an induction-coil, substantially as set forth.

4. In a speaking-telegraph, an induction-coil, a rheostat and a battery in a local circuit, and a main-line circuit passing through a second induction-coil and also through the battery, substantially as set forth.

Signed by me this 8th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. A. SMITH.

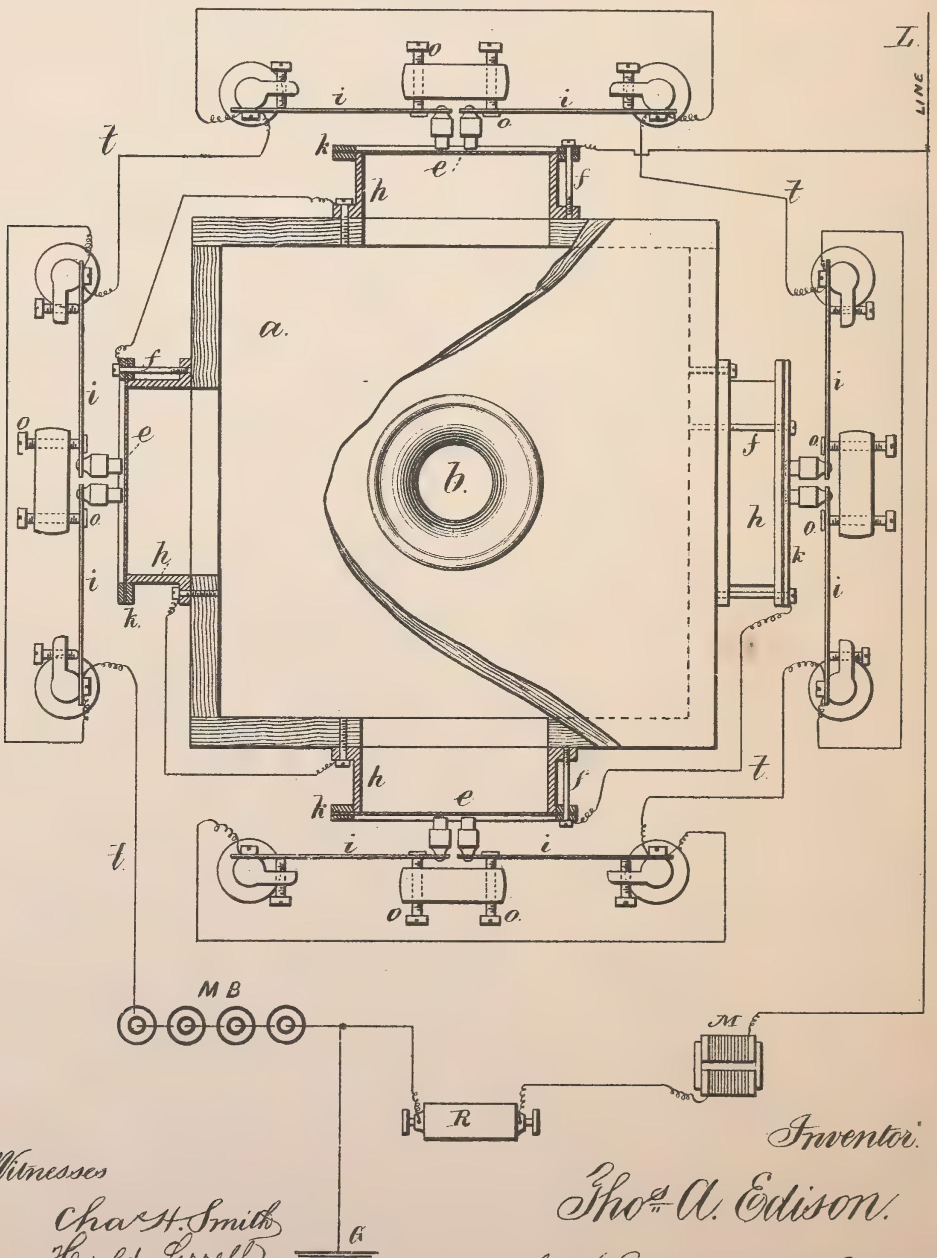
2 Sheets—Sheet 1.

T. A. EDISON.

Speaking-Telegraph.

No. 203,014. Patented April 30, 1878.

Fig. 1.



Witnesses

Chas H. Smith
Harold Serrell

Inventor.

Thos A. Edison.

per Lemuel W. Serrell

atty.

2 Sheets—Sheet 2.

T. A. EDISON.

Speaking-Telegraph.

No. 203,014. Patented April 30, 1878.

Fig. 2.

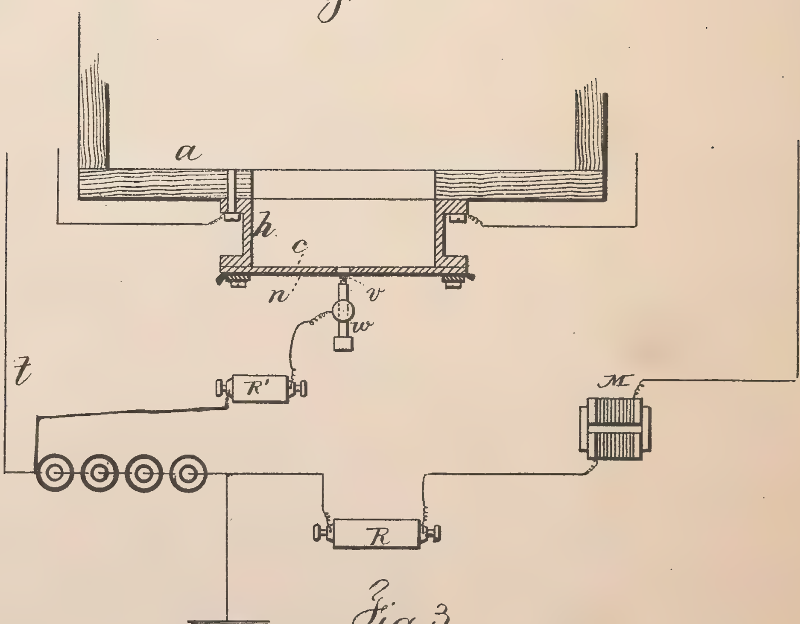
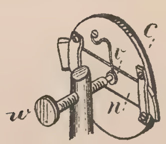


Fig. 3.



Witnesses

Chas H. Smith

Harold Serrell

Inventor.

Thos A. Edison

per Lemuel W. Serrell

atty.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,014**, dated April 30, 1878; application filed July 20, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

I make use of a resonant case with several tympans, adjusted to different degrees of tension or delicacy, and these are all so connected with contact-points in the metallic line-circuit that the electric pulsations will be sent over the line from one or more of these tympans, and operate upon an electro-magnet and receiving-tympan of a resonator.

By this arrangement it is sought to produce such undulations of the electric currents passing over the line that they will represent the inflections of the human voice speaking into the transmitting-resonator, and therefore the receiving-instrument will be correspondingly influenced.

In the drawing, Figure 1 is a plan view, partially in section; and Fig. 2 is an end view of one tympan and circuit-closing device.

The box *a* is of a suitable size and shape. At one side thereof there is a mouth-piece, *b*, adapted to receiving the sounds of the human voice as spoken into the resonant box *a*. This mouth-piece may be upon the top of the box, or at one of the sides thereof.

It is preferable that the hollow resonant box be cubical, in order that at its sides may be placed the tympans aforesaid. I have shown four such tympans. Each tympan is made similar to the head of a kettle-drum, but preferably of a plate of metal, and it covers an opening in one of the sides of the resonant box.

The edge of the tympan *e* is between the rings *k*, and rests against the end of the cylinder *h*; and there are screws *f*, by which to adjust the rings and apply greater or less strain to the tympan.

The tympans are all connected with the metallic line-circuit L, and in front of each there are one or more circuit-closing springs, *i*, preferably with carbon or plumbago points, and each spring is adjusted by the screw *o*, so that the point is in nearer or more remote proximity to the tympan. The springs *i* are all in the circuit *t* to the battery M B, and there is a ground-connection at G, and a shunt from the main line L to G, in which is placed a rheostat, R, and magnet-helix M, to neutralize the static charge and discharge.

It will now be evident that whenever the tympans, or any one of them, are vibrated by the action of the voice, the line-circuit will be connected to the battery, and pulsations sent that represent the vibrations of the tympan. I therefore construct or adjust the tympans so that they respond to different tones or modulations of the voice, in order that when a person speaks into the resonant box the sound will be responded to by one or more of the tympans, and pulsations will be sent upon the line coefficiently, so that the various modulations and tones of the voice will be represented by the electric pulsations, which, acting upon an electro-magnet at the receiving-station, will influence the resonant receiver and produce the same tones, whereby the articulation will be apparent to a listener.

On very long lines, owing to the excessive weakness of sound in uttering the hissing consonants, the electric pulsations resulting therefrom at a certain distance cease to be perceptible.

To overcome this, I arrange the device shown in Figs. 2 and 3 in place of one of the tympans, so as to increase the strength of the consonant waves, as in *ch*, S, T, P. This is accomplished by using a plate, *c*, with a small hole or slot near the center, in front of which is stretched a strip or piece of sheet-rubber, *n*, that is secured near each edge of the disk *c*, and laps a little over the hole in *c*; and upon the rubber is secured a small piece of platina-foil, *v*, an arm of which runs over to and makes connection with the plate *e*. Immediately opposite is a platina contact-screw, *w*, which is connected to the battery through a resistance, R′; and by regulating this, the hissing parts of speech may be increased or decreased instead of being lost, as in the other tympans, owing to the minute amplitude given them by these sounds, and also to the enormous resistance of the plumbago points to the slight pressure which these vibrations give. By using a platina point these vibrations are rendered very loud, and

by the employment of the rubber in front of the aperture in *c* great amplitude is obtained, even to the faintest hiss.

I do not herein make any claim to the transmission of electric currents varying in intensity proportionately to the sound-vibrations, as that is set forth in applications heretofore filed by me; and in my application No. 141, plumbago is described as acted upon by the vibrations of the diaphragm. I do not, therefore, claim the same herein.

I claim as my invention—

1. The combination, in the telegraphic circuit, of two or more tympans, a resonant box, and one or more circuit-closers to each tympan, substantially as set forth.

2. The plate *c*, provided with an aperture, an elastic membrane, and circuit-breaking connections, arranged and operated substantially for and in the manner set forth.

Signed by me this 16th day of July, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,

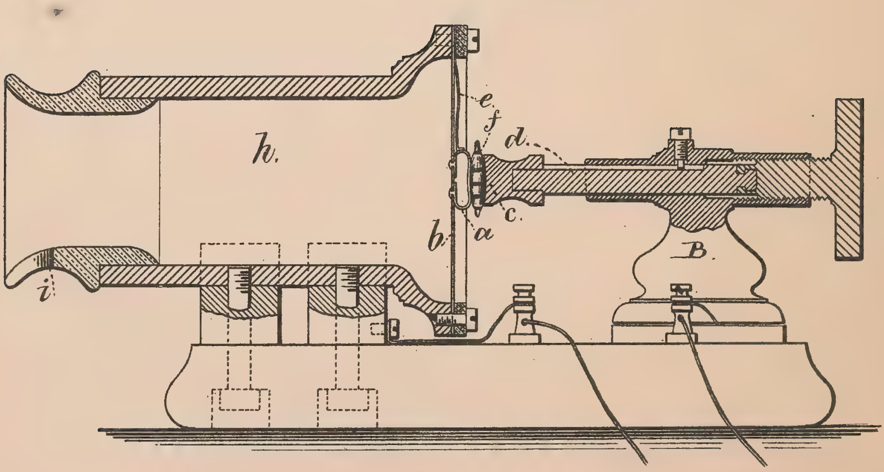
HAROLD SERRELL.

Case No. 143.

T. A. EDISON.
Speaking-Telegraph.

No. 203,015. Patented April 30, 1878.

Fig. 1.



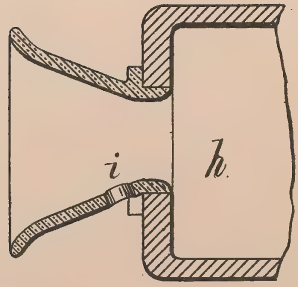


Fig. 2.

Witnesses
Chas H Smith
William G. Mott

Inventor
Thomas A. Edison
per Lemuel W. Serrell
att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,015**, dated April 30, 1878; application filed August 28, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification.

The object of this invention is to transmit and reproduce the human voice over telegraphic circuits.

The invention, which is a modification of an application for patent filed by me April 27, 1877, consists in the following particulars: A mouth-piece provided with a slot or hole to allow of the escape of the air ejected from the mouth in the act of making a hissing consonant, thus preventing a bulging of the diaphragm, and at the same time increasing in a surprising manner the movement of the diaphragm when such hissing sounds are made.

The invention further consists in the employment of mica as a diaphragm. I have discovered that of many substances which are suitable for diaphragms, it alone will give the greatest amplitude of vibration with the least harmonical or extra sound; that it remains unaffected by the heat and moisture of the mouth, and does not get out of adjustment by stretching, like thin substances that have heretofore been used for diaphragms.

The invention further consists in a yielding contact plate-spring secured to the diaphragm so as to allow the diaphragm to make its full vibration while such spring is pressing against the tension-regulator next referred to.

The invention further consists in a tension-regulator made of elastic fiber and electric conducting material, whereby the resistance of the circuit is decreased by the compression of the fiber, bringing the conducting material into more intimate contact, or the resistance is increased by the expansion of the fiber.

In my application No. 141, filed July 20, 1877, a piece of plumbago is described for varying the resistance by pressure, and I have shown a piece of plumbago arranged in front of a diaphragm operated by the human voice, and connected with the telegraphic line in such a manner that when the diaphragm went outward it would cause pressure upon the plumbago, and this would increase the electric wave in the circuit, and if the diaphragm was vibrated weakly a light pressure would be placed on the plumbago, and a weaker wave would be sent, thus producing waves of a strength proportional to the tones of the voice. This does not give as perfect articulation as the tension-regulator I am about to describe, principally on account of the great difference in pressure, or greater amount of pressure required to effect a given change. I have discovered that if any fibrous material—such as silk, asbestus, cotton, wool, sponge, or feathers—be coated, by rubbing or otherwise, with with a semi-conducting substance, such as plumbago, carbon in its conducting form, metallic oxides, and other conducting material, and such fiber be gathered into a tuft and placed in a circuit, it is very sensitive to the slightest movement. I am enabled not only to obtain the regulation by the greater or less pressure, but also to increase or decrease the extent of surface-contact between the particles of conducting or semi-conducting material that is associated with the fiber.

It is best to use fibers that are springy, such as sponge or silk, so as to prevent the materials packing and the regulator losing its elasticity.

I prefer to use unspun silk fiber, cut in lengths of about one-sixteenth of an inch, which are then coated with plumbago by thorough rubbing, or by using a mucilaginous paste of plumbago, rubbing and thoroughly drying, after which the fiber, with a little loose plumbago, is rolled into a cigar shape, and retained by a binding-fiber of silk. I propose to call these "articulators" or "electric tension-regulators."

Another method of metallizing the fiber which I propose to employ is to soak the fiber in a solution of nitrate of silver or other metallic salt, and reduce the metal to a metallic state upon the fiber by a suitable reducing agent, such as exposing the silk to the fumes of phosphorus, this process of metallization being well known among electroplaters for causing non-conducting articles to become conductors for receiving a deposit of metal thereon.

The fiber may be moistened with a semi-conducting fluid, and operate in precisely the

same manner, the resistance being lessened by compressing the fiber, and vice versa.

The electric tension-regulator *f*, I place between a conducting-spring, *a*, secured to the diaphragm *b*, and the conducting point or plate *c*, secured to the adjusting-post *d*, and adjust it so that when the diaphragm is in a state of rest the regulator will remain in contact with both *a* and *c* by pressure. This tension-regulator may be employed in various electric instruments—such as rheostats—to regulate the electric current passing at a given place according to the pressure exerted upon the mass of fiber.

In the drawing, Figure 1 is a section of a transmitting-instrument with my improvements applied thereto. Fig. 2 is a modification of the mouth-piece.

The line-circuit passes to the spring in the center of the diaphragm by the platina foil *e*; thence through the articulator or tension-regulator *f* and contact *c* to the pillar B; thence to battery and earth or return wire.

At the distant station the line enters any suitable receiving-instrument, which may be an electro-magnet secured to a resonant box or operating-diaphragm operated by the armature or other device.

The plate *a* is attached firmly to the mica diaphragm or tympan *b* by making small holes in the mica and soldering the plate to the mica, the solder entering the holes and adhering by the roughness of the surfaces of such holes.

When the diaphragm on the transmitter is in a state of rest, the circuit is closed, and a constant but weak current passes through the circuit, the tension-regulator offering, say, two thousand ohms resistance.

If the slightest sound is made near the mouth-piece, the diaphragm is set vibrating, and the fibrous regulator is compressed and expands at each vibration, thereby increasing and decreasing its resistance many ohms, and causing a rise and fall of tension within the circuit, and these waves so produced act upon the distant receiving-instrument, when these vibrations are reproduced.

In speaking into the case *h*, or into the resonant-box of any telephone, there is difficulty in transmitting the sounds from consonants, because the hissing sound produces a pressure upon the diaphragm instead of a vibration. I obviate this difficulty by an opening in the speaking-tube with an edge or angle, against which the hissing sound is directed, and which responds to such sound, and communicates the same to the diaphragm; and as this hissing sound, in pronouncing some of the consonants, passes downwardly from the mouth, I introduce a notch or orifice, at *i*, in the lower part of the speaking-tube *h*, so that, the sound passing down through the slot and striking the sharp edges of the slot, the hissing sounds are intercepted and cut and turned into vibrations, and these, acting upon the diaphragm, increase enormously the distinctness and volume of the hissing sounds at the receiving-instrument.

In speaking-tubes where there is no slot the air ejected in pronouncing hissing consonants, having no escape, causes the diaphragm to bulge outward, and so lessen the resistance of the circuit, and not transmit the hissing sounds except when exceedingly loud. A large hole in the tube near the diaphragm prevents the bulging of the diaphragm; but it does not increase the effect of the hissing sounds, but on the contrary weakens them, as well as the vowel-sound.

It is obvious that many modifications of the mouth-piece may be made so long as the holes or slots are located so that their edges cut the hissing sounds for the purpose set forth. A tube with a hole or slot, *i*, having a sharp edge between the mouth-piece and diaphragm, as in Fig. 2, may be used.

I have found that mica, owing to its being composed of innumerable layers of thin sheets, does not give a ringing sound or harmonics like most other substances which have equal strength, rigidness, &c., especially metals, and it is not affected, except in an unimportant extent, by the heat and moisture from the mouth; neither does it stretch like metal. All these properties are essential in a speaking-telegraph for insuring permanency and absence of false vibrations or harmonic responses, and for obtaining perfect articulation.

Animal membranes are inconstant, and are too sensitive to heat and moisture, and are constantly stretching. I use a spring in the center of the diaphragm, which is somewhat weaker than the diaphragm, and this is for the purpose of allowing the diaphragm to have a more free movement, the spring serving to take up by its elasticity the effect of the sudden check of the diaphragm when the fiber has been compressed too greatly by loud speaking.

The adjusting-post *d*, by preference, is made so that the disk is brought toward the diaphragm without being turned, so as to prevent disturbing the fibrous tension-regulator.

It is obvious that many devices (other than the mere pressure of the diaphragm against the conducting-fiber) may be used to secure the fiber.

I claim as my invention—

1. In an instrument for transmitting electric impulses by sound, a diaphragm or tympan of mica, substantially as set forth.

2. In an instrument for transmitting electric impulses by sound, the combination, with a diaphragm or tympan, of an electric tension-regulator of fiber and electric conducting material, substantially as set forth.

3. An electric tension-regulator composed of elastic fibrous and electric conducting material.

4. The combination, in an electric instrument actuated by sound, of a diaphragm or tympan, a conductor, and an electric tension-regulator composed of elastic fiber and electric conducting material.

5. The combination, with an electric ten-

sion-regulator composed of fiber and electric conducting material, of a variable presser acting upon such fiber, substantially as set forth.

6. The combination, with a diaphragm or tympan of mica, of an electric conductor and pins of solder passing into holes in the mica to secure said conductor, substantially as set forth.

7. In an instrument for transmitting electric impulses by sound, a resonant case having an opening near the mouth-piece, substantially as and for the purposes set forth.

8. In an instrument for transmitting and reproducing the human voice or other sound, a closed telegraphic circuit containing a battery and compressible elastic material operated by the sound, for increasing and decreasing the resistance to the battery-current, substantially as set forth.

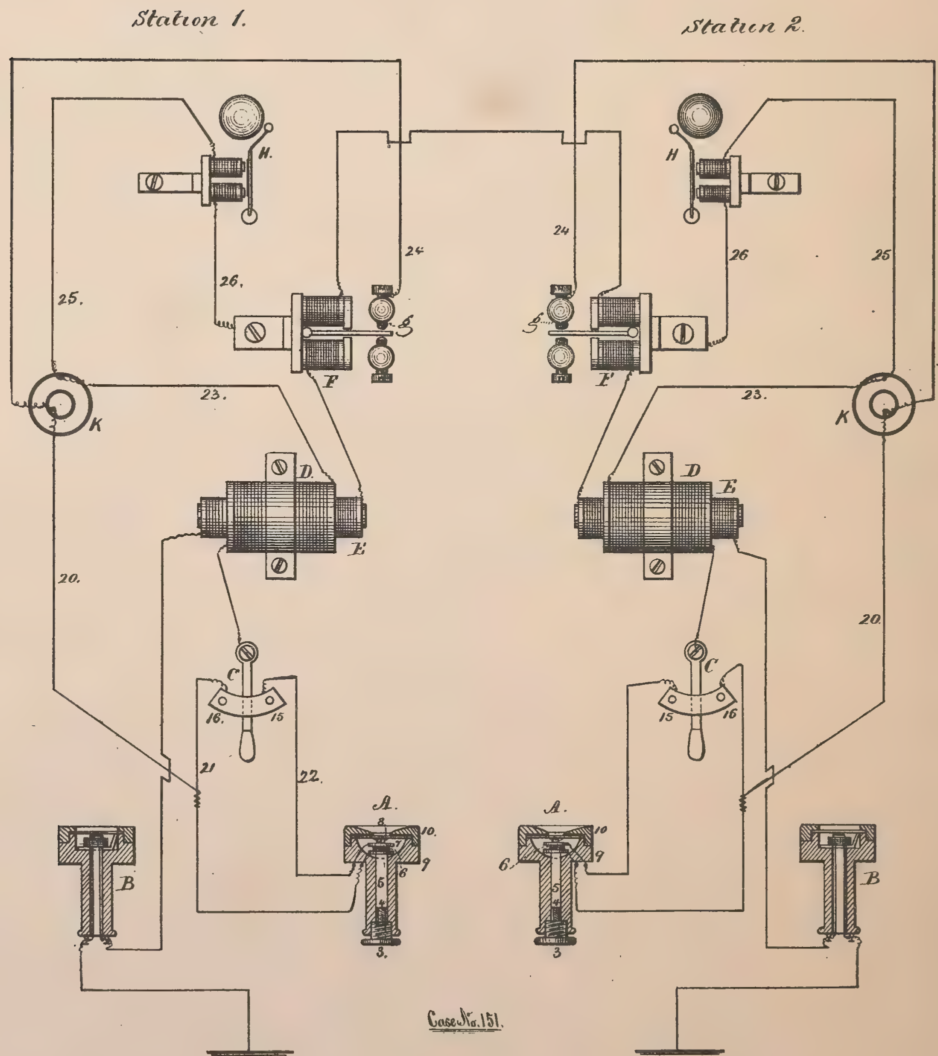
Signed by me this 16th day of August, A. D. 1877.

THOS. A. EDISON.

Witnesses:
WILLIAM G. MOTT,
CHAS. H. SMITH.

T. A. EDISON.
Speaking-Telephone.

No. 203,016. Patented April 30, 1878.



Witnesses
Chas H. Smith
Harold Serrell

Inventor.
Thos A. Edison.
per Lemuel W. Serrell atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **203,016**, dated April 30, 1878; application filed March 7, 1878.

CASE 151.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Acoustic Telegraphs, (Case No. 151,) of which the following is a specification:

The object of this invention is to transmit and receive oral communications over telegraphic wire by sound.

The invention relates to an arrangement of devices for transmitting two classes of signals—one by the vibrations of the voice and the other by a key or switch for signaling the distant station.

In my application No. 141 for Letters Patent, filed July 20, 1877, I have shown a carbon disk acted upon by the vibrations of a diaphragm to produce rise and fall of electric tension upon the line, such carbon disk being in the main-line circuit; and in my application No. 146, filed December 13, 1877, I have shown a rheostatic device acted upon by the diaphragm to produce rise and fall of tension in the primary circuit of an induction-coil.

I find that the carbon heretofore employed in connection with a diaphragm is not adapted to use in the primary circuit of an induction-coil, because its resistance is too great, and the necessary rise and fall of tension is not produced.

If the carbon is mixed with other substances, so as to separate the particles, the rise and fall of tension can be obtained; but its resistance is too great to be used in the primary circuit of an induction-coil.

I have discovered that lamp-black obtained from the combustion of very light hydrocarbons, such as gasoline or naphtha, can be used for the aforesaid purpose.

I select from lamp-black thus made only the very blackest portions, and then place the same in a mold, and subject it to a very powerful pressure, sufficient to consolidate the same, and place it in a correspondingly-shaped cavity contiguous to the diaphragm, with a piece of cork or a piece of rubber intervening between the same and the diaphragm, and connect the disks of platina foil that are used at each side of the carbon in the primary circuit of the induction-coil, and obtain from the pressure resulting from the motion of the diaphragm the necessary rise and fall of tension without the great resistance heretofore inseparable from the carbon in said circuit.

I will now describe the action of the apparatus.

A at station 1 is the carbon-transmitter. 9 is the body of the telephone. 10 is the cap for securing the diaphragm tightly. 8 is a piece of cork and rubber tube secured to the diaphragm. The rubber tube rests, when properly adjusted for speaking, against an ivory disk, 7. The ivory disk rests upon a disk of platina foil resting upon a button of lamp-black carbon, 6. This, in its turn, rests upon the platinized surface of the rod 5, which is adjustable to and from the diaphragm by the right and left hand screws 3 and 4.

The platina on the top of the carbon disks next to the diaphragm is connected to a binding-post, and to the other binding-post a wire connects with the rod 5. Thus the circuit must first pass to the upper platina and through the carbon to the lower plate.

The vibrations of the diaphragm subject the carbon to different pressures, according to the amplitude of motion resulting from the sound-waves, and this difference of pressure varies the resistance offered by the carbon to the passage of the current, and produces a rise and fall of electric tension.

The instrument A is included within the primary circuit of the induction-coil D E. D is the primary wire of the coil, and is wound on the outside of the secondary coil E. C is a switch, which, when moved to the right in contact with 15, places the transmitter A in the primary circuit containing the battery K and coil D. When the switch is in the center, the primary circuit is open and the apparatus is ready for the reception of a call-signal. When the switch is turned to the left, at 16, the instrument A is thrown out of circuit, and the battery only is connected to the primary coil D.

The movement of the switch from 16 several times serves to open and close the primary circuit and throw a powerful induced current into E, and then to the line.

The polarized relay F, coil E, and receiving-

instrument B are all placed in the main-line wire at both stations. The powerful current thrown into the secondary coil and line by the movement of the switch C from 16 works the tongues of both polarized relays F in unison with the switch. The tongues, closing against their contact-points, close a local circuit containing a call-bell, H.

The same battery K that is employed with the telephones is utilized to ring the bell. The connections for the transmitter A are from the battery K, by wire 20, to 21, then through the telephone A to wire 22, and from 22 to 15, through the switch-lever C, to the primary coil D and to wire 23, back to battery. This is the connection for transmitting and receiving telephonically. When not thus working, the switch C is placed in the central position between 15 and 16. When in this position, if the switch of the distant station is moved to operate the call, the tongue of F closes the local circuit at *g*; thence, by wire 24, to battery K, and through K to wire 25; thence through the magnets of the bell-call to wire 26, and then through the tongue of the polarized relay.

When the switch C is moved to work the distant call it is brought into contact with 16, and the current passes from K, by wire 20, to 16; thence through C to the primary wire D; thence to 23, back to the battery K, setting up a powerful induced current in the coil E and line.

I will mention that it is not necessary to use a polarized relay, as an unpolarized relay of the ordinary character may be used, as the current due to the opening of the primary circuit is much the strongest; but the lever of the unpolarized relay should be light and the spool very short. It is not even necessary to use the call-bell H in many instances, when the terminal is very quiet, as the sound given by the polarized relay itself is sufficient; or a small bell may be worked by the tongue.

The tongue of a polarized relay should be biased, so that it will always be away from the point *g*, except when moved by the signaling-currents, so as to prevent short-circuiting the battery K when transmitting telephonically.

By employing two cells and a considerable resistance in the magnets upon the call-bell, it is not essential to bias the tongue; but it may be made to respond to both positive and negative, a shunt from one cell being used to furnish current to the call-bell.

I claim as my invention—

1. The combination of transmitter A, coils D E, switch C, polarized relay F, bell H, battery K, and circuits, arranged and operating substantially as herein set forth.

2. In combination with a telephonic and the primary circuit of an induction-coil, the button of lamp-black carbon, prepared as set forth, and placed in the primary circuit, substantially as and for the purposes set forth.

Signed by me this 28th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
HAROLD SERRELL,
GEO. T. PINCKNEY.

T. A. EDISON.
Telephone Call-Signal.

No. 203,017. Patented April 30, 1878.

Fig. 1.

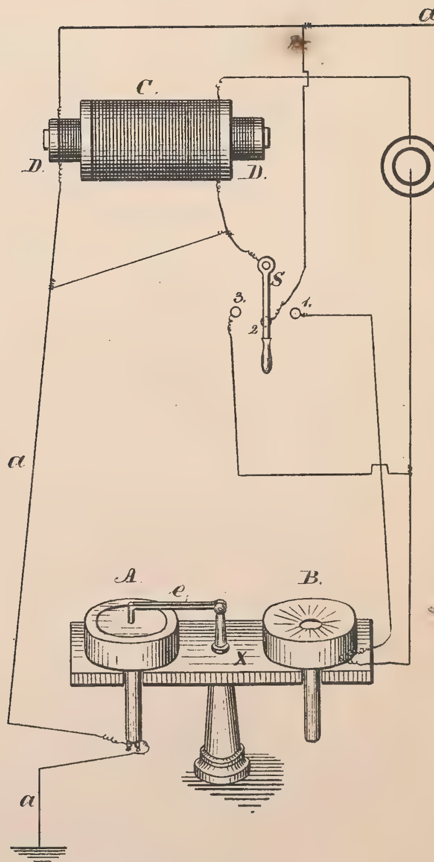
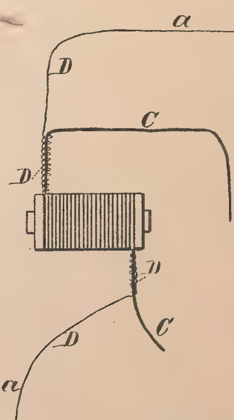


Fig. 2.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEPHONE CALL-SIGNALS.

Specification forming part of Letters Patent No. **203,017**, dated April 30, 1878; application filed March 4, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telephone-Calls, (Case No. 152,) of which the following is a specification:

The object of this invention is to provide a simple apparatus for a signal-call on a telephonic circuit.

The invention consists in a stand for the receiving-instrument and a swinging metal lever, the end of which comes into contact with the diaphragm, so that it is thrown from it violently when a strong wave or current passes over the line or through the magnet of the receiving-instrument. This lever, in returning, strikes the diaphragm a blow, and produces a sharp penetrating sound like that of a Morse sounder, and this may be heard in all parts of a large room.

I have heretofore shown, as in Case No. 146, an induction-coil in connection with a telephone. I arrange a switch between the local and main-line circuits, in such a manner as to vary the electric tension on the line by moving such switch, and thereby operating the call at the distant station; and I prefer to employ a peculiarly-constructed induction apparatus, in which there is a fine wire wound helically around a larger wire, and then the two are wound to form a helix. The larger wire is in the local circuit, and forms the primary induction-coil, and the induced current is set up in the finer helix.

If a soft-iron bar passes through the coil, its inductive force is increased; but the clearness of the sound received upon the telephone is lessened thereby.

In the drawing, Figure 1 is a diaphragm of the circuit-connections, and Fig. 2 shows the induction-coil separately.

A is the receiving-instrument, provided with a diaphragm and a magnet for giving motion to it. This is included in the main line *a a a a*.

C is the primary coil; D, the secondary coil, which latter is included in the main-line circuit. *e* is the sounder-lever, resting upon the diaphragm of A. X is a rack or stand for holding both the receiving and transmitting instruments when not in use. S is a switch. When it is turned to the point 1, the transmitter B is included in the primary circuit with coil C and battery Q, and the transmitter serves to increase and decrease its resistance when the diaphragm is vibrated by sound.

There is a carbon disk, through which the current passes, and it produces more or less resistance, according to the amplitude of vibration of the diaphragm, causing greater or less pressure on the carbon.

When the switch-lever S is moved to the point 2, the secondary wire of the coil is short-circuited. It remains in this position for the reception of a call-signal from the distant station. Were the coil D left in circuit it would tend to weaken the signal-call by its resistance to the passage of the current from the distant station.

When the switch-lever is at the point 3, the current from the battery Q passes only through the primary wire. By connecting and disconnecting the switch S from this button 3, powerful induction-waves are thrown into the line, and act upon the distant receiver to attract and repel the lever *e* and give the signal-call.

Fig. 2 illustrates the construction of my improved induction-coil. In this the large wire C forms the primary coil, and the fine wire D, wound around the same, forms the secondary coil, the latter being placed in the main circuit and the former in the local circuit, as heretofore explained.

I claim as my invention—

1. In combination with a receiving telephone-instrument having a diaphragm and electro-magnet, a swinging lever placed with its moving end in contact with the receiving-diaphragm, and a switch or key for increasing the electric current and operating the lever as a sounder or call upon the diaphragm, substantially as set forth.

2. In combination with the telephone-transmitter B and receiver A, the induction-coil C D, battery Q, local circuit, switch S, and

circuit-connections, substantially as and for the purposes set forth.

3. In combination with the main-line circuit and local circuit, and the telephonic instrument, the induction-coil composed of two wires, the largest of which is surrounded by a finer insulated wire wound helically, the two being then wound into a helix to form the induction-coil, substantially as set forth.

Signed by me this 28th day of February, A. D. 1878.

THOS. A. EDISON.

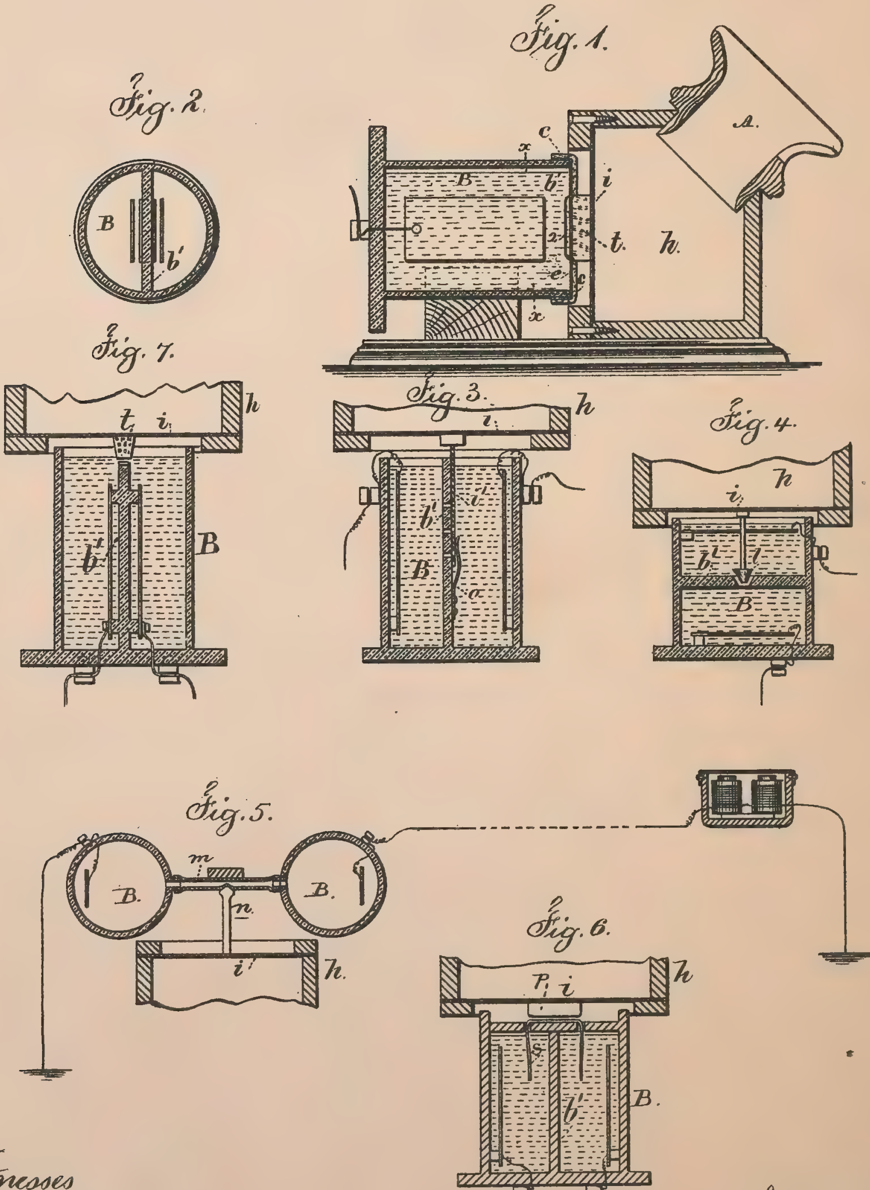
Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

Case 147.

T. A. EDISON.

Telephone or Speaking-Telegraph.

No. 203,018. Patented April 30, 1878.



Witnesses

Chas H. Smith

Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

atty

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN TELEPHONES OR SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,018**, dated April 30, 1878; application filed December 13, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

I make use of two or more cells containing a mobile fluid, and these fluids are insulated from each other except when they come together at a narrow opening or space, and there is an electrode in each cell, and the diaphragm or other body vibrated by the atmospheric sound-waves regulates the opening or the pressure at this point, so as to vary the electric tension on the line to correspond with the sound vibrations.

In the drawing, Figure 1 is a vertical longitudinal section of an acoustic transmitter fitted with my improvement, and Fig. 2 is a cross-section at the line *x x*.

B is a cylinder of insulating material, divided by a partition, *b′*, into two compartments or cells filled with a conducting-fluid. In each cell is an electrode of platina, carbon, or other conductors, one of which is connected to the line-wire, and the other to the battery and earth. The top portion of the partition *b′* is slightly hollow, leaving a passage-way, 2, for the fluid and current to circulate from one cell to the other.

Resting upon the face of the cylinder is a flexible head of mica, rubber, or other non-conducting material, *e*, impervious to the fluid, and over this is secured a cap, *c*, provided with a slot. When the cap *c* is securely fastened to the cylinder, the diaphragm prevents any of the fluid from circulating from one cell to the other except through the small aperture at 2, made by the curve on the end of the partition *b′*. *h* is a box with a mouth-piece, A, and at one side of the box is secured the diaphragm *i*, and upon the diaphragm is a piece of cork, *t*, which extends outward from it, and through the slot in the cap *c*, on the head of the cylinder B, and comes in contact with the mica or rubber flexible head *e*, to which it may be secured by a cement, although this is not actually necessary.

The operation is as follows: When the diaphragm *i* is properly adjusted to the diaphragm in the cylinder B, the space for the circulation of the fluid from one cell to the other is very narrow. If, now, the diaphragm is set in vibration by a sound, the passage-way is increased and decreased in size at every vibration, thus increasing and decreasing the resistance to the passage of the current from one cell to the other, owing to the alteration in the size of the liquid conductor. If the amplitude of the diaphragm is very great, the space is nearly, if not altogether, closed at the forward movement, and widened to its fullest extent by the backward motion; and if the amplitude is small, only a slight increase and decrease in size of the aperture take place, according to the size of the opening, so there will be more or less resistance to the current passing through the liquid at this point, and there will be a corresponding rise and fall of electric tension on the line at this point.

It is obvious that with a mobile fluid all the harmonical and other sounds incident to articulation act to produce corresponding changes of electric tension.

The opening that connects one cell with the other is small, and at the side of the electrodes, in preference to being above them; hence the gas formed by decomposition of the fluid from transmitting does not interfere with the operation, nor produce extra sounds, and at the same time a great increase and decrease in the strength of the current are effected by the slightest movement of the diaphragm.

There are many forms of apparatus in which my improvement may be employed.

In Fig. 7 the cylinder B is represented as standing vertically instead of horizontally, as in Fig. 1, which permits of the diaphragms *e* and *c* being dispensed with. In Fig. 3 I have represented several narrow slits in the partition *b′*, between the cells, and a thin strip of metal, *i′*, from the diaphragm *i*, running down at the side of the partition, and also slotted; but the slots in the normal position do not correspond; hence, by the vibration of the diaphragm, the openings are increased or lessened, and the resistance to the electric current increased or decreased. A spring, *o*, may be used to hold the plate to the partition.

Fig. 4 shows the partition *b′* arranged horizontally, the passage-way from one cell to the other being controlled by a valve or plunger,

l, arranged at an aperture through the partition. In Fig. 5 the passage-way is between two independent cells, by means of a flexible tube, *m*, and the opening is increased or lessened by the movement of the diaphragm acting through a finger, *n*, that presses upon the flexible tube.

I will mention that mercury may be used instead of an electrolyte; or a porous material, such as paper, may serve to connect the cells together, as in Fig. 6.

s represents a piece of porous material, such as paper or muslin, and the ends pass into liquid in the cells, so as to be kept moist by capillary attraction, and adjacent to this is a presser, *p*, connected to the diaphragm or other vibrating body, so as to be moved by the same and press with more or less force upon the moistened strip, and interrupt the passage of electricity more or less, according to the amplitude of vibration.

I do not herein claim a mica diaphragm, the same being set forth in my prior application No. 143, filed August 28, 1877. Neither do I herein claim a device for effecting a rise and fall of electric tension by a motion derived from the diaphragm, that having been set forth in my prior application No. 130, filed April 27, 1877, and in my application No. 144, filed September 5, 1877, the electrodes are moved to vary the resistance to the electric current passing through a liquid. In the present instance the electrodes are stationary.

I claim as my invention—

In an acoustic-telegraph apparatus, the combination of two stationary electrodes immersed in two cells, a conducting-fluid in said cells, and a fluid-connection between such cells, and mechanism actuated by a sound-vibrated body, for varying the dimensions of such liquid-connection and the conductivity of the same, substantially as set forth.

Signed by me this 8th day of December, A. D. 1877.

THOS. A. EDISON.

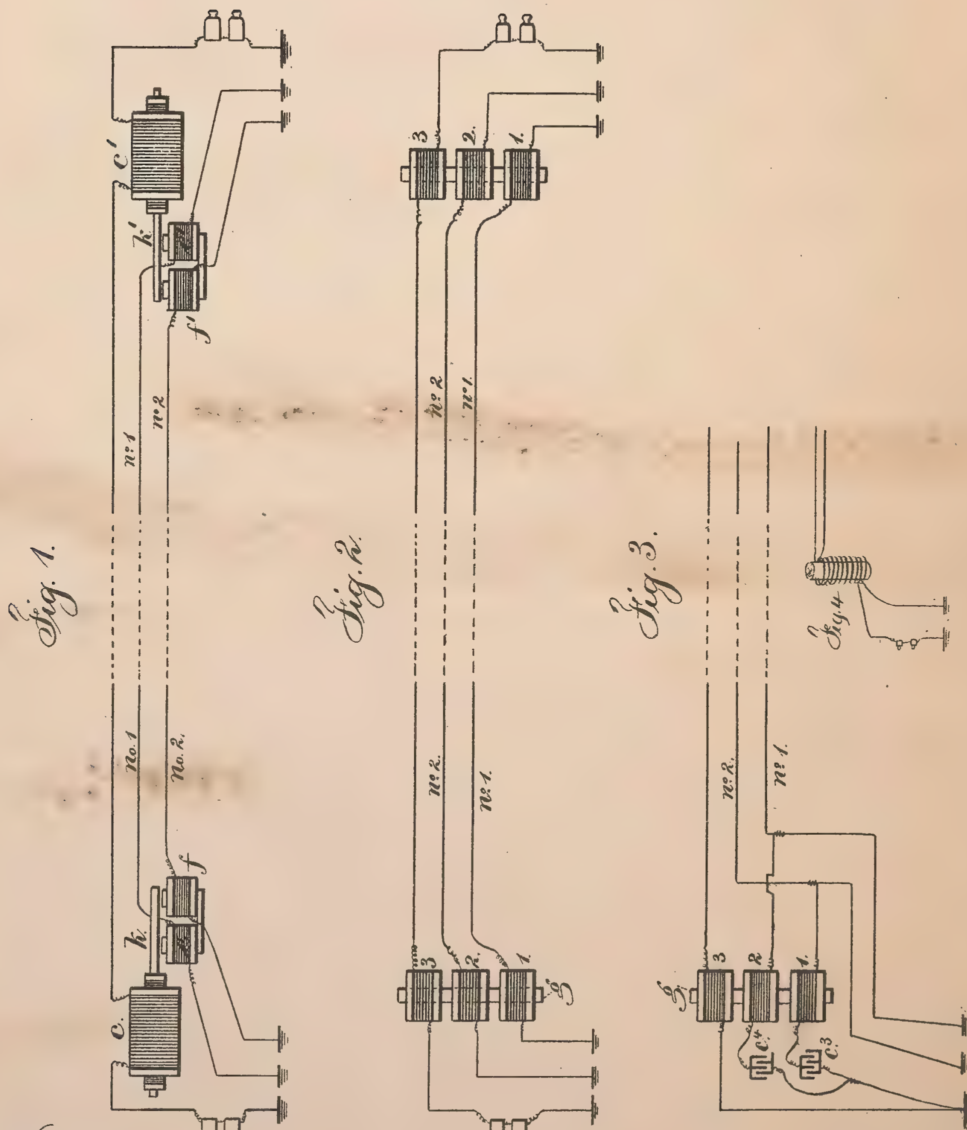
Witnesses:

GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.

Circuits for Acoustic or Telephonic-Telegraph.

No. 203,019. Patented April 30, 1878.



Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison.
per Lemuel W. Serrell
atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CIRCUITS FOR ACOUSTIC OR TELEPHONIC TELEGRAPHS.

Specification forming part of Letters Patent No. **203,019**, dated April 30, 1878; application filed February 21, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Circuits for Acoustic Telegraphs, (Case No. 150,) of which the following is a specification:

In telegraph-lines there are very often numerous wires running in the same direction upon the poles, and it has long been known that currents passing through one or more of said wires set up induced currents in the other wires. These ordinarily are harmless in the Morse and other systems of telegraphy; but where a wire for a telephone, acoustic, or speaking telegraph runs parallel to or within the field of the electric influence of another wire, there are false and confusing sounds at the receiving-instrument that greatly interfere with hearing the message sent upon such acoustic lines.

The object of the present invention is to compensate, neutralize, and destroy the extraneous or induced currents from contiguous circuits, so that the messages will not be in any manner interfered with by false currents.

The invention is primarily adapted to telephonic circuits, and is so described herein; but it may be used with any instruments where it is desirable to neutralize such extraneous currents.

The present invention consists in the combination, with the telephonic circuit or other circuit to be freed from external influences, of an induction-coil, connected with the contiguous circuits in such a manner that a reactionary induction is established in the telephonic line of a power corresponding and similar to the primary inductive action, but opposed to the same, so as to entirely oppose and neutralize the action of the same.

In the drawing, Figure 1 is a diagram representing one of the forms in which the aforesaid compensation is effected. The large coils c c' are included in the telephonic circuit at each end of the line. In the coils are iron cores, surrounded by a primary coil, the ends of which may or may not be connected together, according to the compensation desired.

The iron core extends outside of the coils some distance. I have shown compensation for two circuits only. These circuits, which I call "No. 1" and "No. 2," running in close proximity to the telephone-wires for many miles, induce a momentary current in it every time the circuits are opened or closed, the strength of which is proportionate to the proximity of the wires to each other and the number of miles that they run side by side.

These induced currents are in one direction in closing the circuit, and the opposite direction on opening the circuit. To neutralize the induced current from, say, No. 1 circuit, I place electro-magnets e e' at each terminal in the circuit of circuit No. 1.

These magnets are then adjusted to approach the iron cores k k' until the induced current thrown into the coils c and c' and telephone-line by the action of the magnets e and e' is equal, but opposite to, the induced current from the circuit No. 1 thrown into the telephonic wire by running parallel to it. Thus a perfect compensation is attained.

If the two lines run parallel for long distances I connect the two ends of the primary coil on c and c' together, and thus retard the magnetism and demagnetization of the cores k k', and consequently lengthen the induced currents thrown into c and c' by the action of e' and e.

Having thus compensated for circuit No. 1, the compensation for circuit No. 2 is exactly similar. If the latter circuit does not affect the telephone-circuit as strongly as No. 1, the electro-magnets f and f' are placed a greater distance from k and k'; the latter may be elongated, and compensation attained from many circuits by employing separate magnets in each circuit which affects the telephonic circuit.

Owing to the great diversity in the character of the induced currents thrown into telephonic wires from wires in close proximity—due to different lengths and the employment of different battery powers and systems of transmission—many methods to meet special conditions are necessary. Thus in Fig. 2, where the circuits 1 and 2 employ powerful batteries and reversals and many magnets are in circuit, the induced currents thrown into the tele-

phonic wire are exceedingly powerful; hence a more powerful means of compensation is necessary.

In Fig. 2, g is an iron core, over which there are three or more coils—one for each line-circuit. The coils 1 and 2 are in the ordinary or Morse circuits Nos. 1 and 2, while coil 3 is in the telephonic circuit. The coils are so wound and arranged, in relation to the induced currents thrown into the telephone-wire by the proximity of the other wires that they will act in the iron core g to set up a magnetism therein that will cause a powerful induced current to pass into coil 3 and telephonic line opposite in direction to the induced currents in the telephonic line due to the proximity of the other wires.

It is obvious that these coils may be inserted at any number of points along the line, and that the intensity of the reverse currents will be proportionate to the intensity of the currents exerting the inductive influence, and hence they will always be neutralized.

In cables containing a number of wires there is not only dynamic induction, but static induction. The latter appears sooner than the former, and is of exceedingly short duration, so that magnetic compensation alone is too sluggish. In Fig. 3 is shown a modification of Fig. 1 to meet this condition, which it does to a considerable extent, but not entirely.

The induction-coils 1 and 2 are included in derived circuits from the line-circuits 1 and 2, that pass to the condensers c^3 and c^4, and to the earth. The object of the condensers is to prevent any leakage of current from the circuits 1 and 2, and at the same time to hasten the magnetizing and demagnetizing of the cores g, so that an induced current of momentary duration is set up in coil 3 to meet and compensate for the static current from the circuits 1 and 2.

I will here mention that, to obtain perfect compensation, both the static and dynamical induced currents must be set up in the compensations so they will circulate in the telephonic wire in a direction opposite to those induced by proximity of the wires; and to obtain these conditions, both magnets and condensers are necessary—the former to set up dynamical induction-currents, and the latter statical currents.

In my apparatus, if current No 1 is opened there first appears a short wave of current due to static induction, then an interval, and then the dynamical inducted current appears, which gradually dies away to nothing; hence, a compensation which will eradicate the dynamical current will leave that due to static induction free to circulate, and this cannot be eradicated by an induced current from a magnet, because time is required to charge and discharge the cores and the consequent production of the induced current.

Upon short circuits I use a coil with two or more wires, wound side by side upon a wooden bobbin, as shown in Fig. 4. One wire is placed in the telephonic circuit, while the others are placed in the circuits to be compensated for, and so connected therewith that the currents thrown into the telephonic coil are equal but opposite to those due to induction resulting from the wires running parallel.

By employing large wires, and a large quantity of it, I am enabled to obtain nearly perfect compensation, as the coils set up both dynamical and statical currents, no iron cores being used to retard the appearance of the currents.

Instead of the coil of several wires wound side by side, several long strips of tin-foil may be placed side by side and insulated from each other, and the currents passed through the strips in the same manner as if they were wires.

Another method consists in providing the telephonic receivers with differential coils, and running another wire parallel with the telephonic wires, and including in it the subsidiary coil.

I claim as my invention—

The method herein specified of compensating in one circuit for induced currents from adjacent circuits, consisting in setting up a reactionary induction by an induction-coil connected with the adjacent circuit or circuits, substantially as set forth.

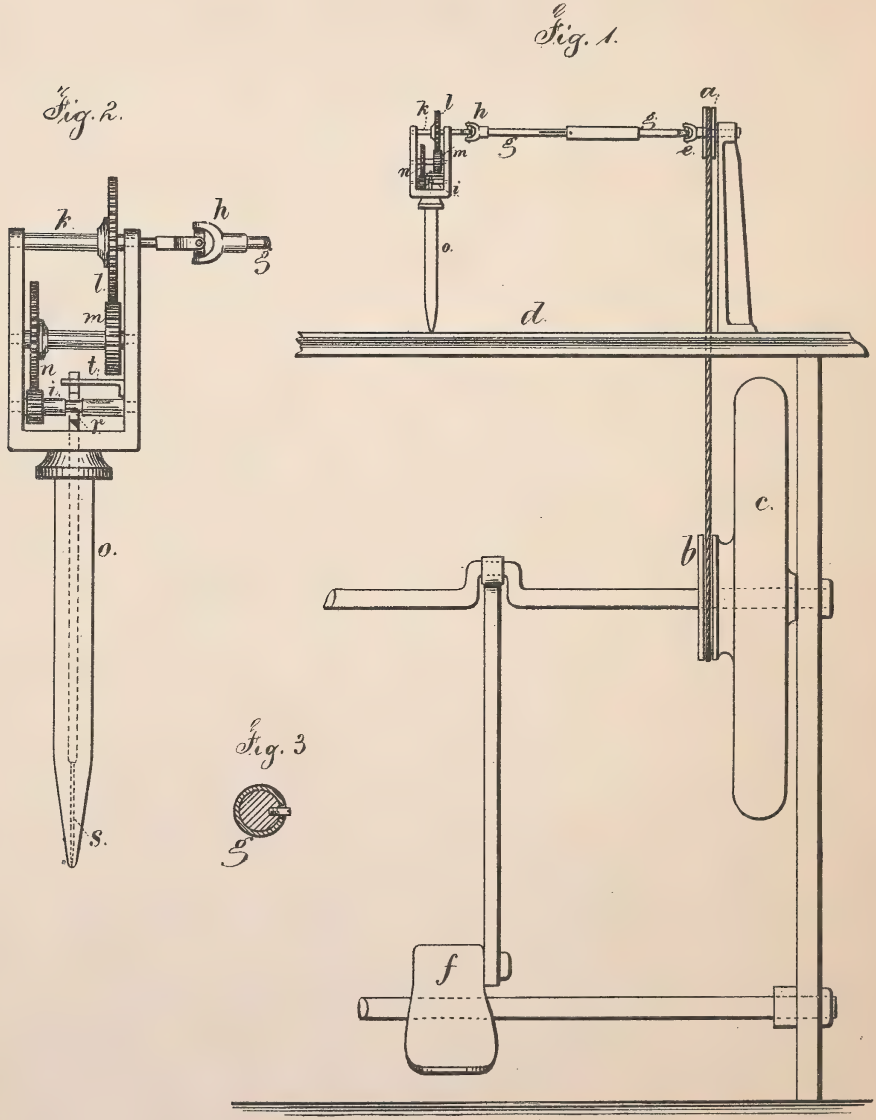
Signed by me this 13th day of February, A. D. 1878.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Perforating-Pen.

No. 203,329. Patented May 7, 1878.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor.
Thomas A. Edison
per Lemuel W. Serrell
Att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PERFORATING-PENS.

Specification forming part of Letters Patent No. **203,329**, dated May 7, 1878; application filed April 23, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Perforating-Pens, of which the following is a specification:

This invention is an improvement upon and modification of the device patented to me, No. 180,857, and dated August 8, 1876.

The present invention relates to a means for reciprocating the needle that is used for perforating the paper.

I employ a motor that is revolved by foot or other convenient power, and gives motion to a shaft with universal joints that passes to the pen and revolves the mechanism that reciprocates the pen, and at the same time the universal joints allow the pen to be manipulated in writing or drawing. It is also preferable to employ a tube and sliding rod extending from one universal joint to the other, that allows the distance to be increased or lessened between the universal joints.

In the drawing, Figure 1 is an elevation, illustrating the connection between the motor and the pen. Fig. 2 is a side view of the pen in larger size; and Fig. 3 is a section of the tubular connection in magnified size.

The wheel *a* is revolved by suitable power. It will generally be preferable to connect the same by a belt with a larger wheel, *b*, and fly-wheel *c*, either above or below the table *d*, actuated by a treadle, *f*.

The universal joint *e* is at one end of the shaft *g*, connecting the same to the shaft of the wheel *a*, and this shaft *g* extends to the universal joint *h* of the shaft *k*. It is preferable to have this shaft *g* in two parts, one a tube, and the other a rod sliding within it, there being a groove or feather (see Fig. 3) that allows the one part to be revolved by the other, and at the same time the distance between the joints *e* and *h* can vary, to adapt the position of the pen to the place where the writing is being performed.

The shaft *i* is revolved with great rapidity by means of the train of gearing *l m n* extending between the shaft *k* and the shaft *i*. The shafts of this train of gearing are supported in the light metallic frame above the tubular pen-holder *o*, within which is the needle *s*, that is reciprocated by a cam or eccentric, *r*, upon the shaft *i*. The guide *t* serves to maintain the upper end of the needle-holder in its proper position. The penetrating needle-point acts, as described in my aforesaid patent, to perforate the paper in drawing or writing, and the subsequent printing from the perforated sheet is to be done in the manner described in said patent.

I claim as my invention—

1. The combination, with an autographic perforating-pen, and the cam or eccentric to operate the same, of the universal joints and shaft *g*, connecting and giving motion from a motor to the mechanism upon the pen, substantially as set forth.

2. The extension-shaft *g*, made in two parts, one sliding within the other, and provided with universal joints at the ends, in combination with a motor and a pen formed of a reciprocating needle, a holder, and mechanism for moving the pen, substantially as set forth.

3. In combination with the autographic perforating-pen, the train of gearing upon the pen to increase the speed of the pen, and a motor connecting with the train of gearing upon the pen, substantially as set forth.

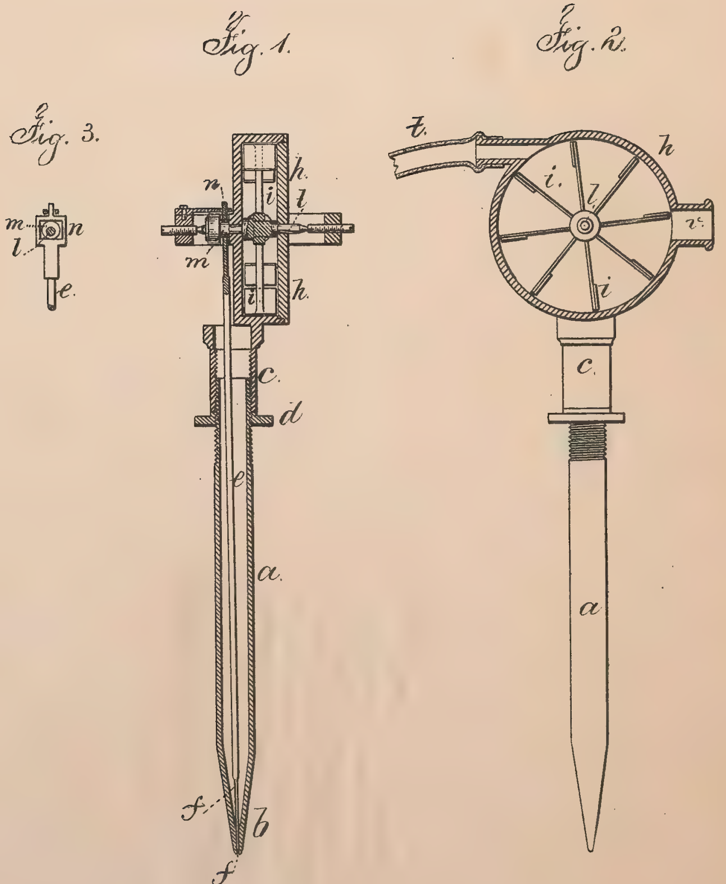
Signed by me this 18th day of April, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Pneumatic Stencil-Pen.

No. 205,370. Patented June 25, 1878.



Witnesses,
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN PNEUMATIC STENCIL-PENS.

Specification forming part of Letters Patent No. **205,370**, dated June 25, 1878; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Autographic Printing, of which the following is a specification:

In Letters Patent granted to me August 8, 1876, No. 180,857, an instrument is described for puncturing paper for use in autographic printing, consisting of a needle-pointed rod moving within a tube or holder, and reciprocated by a cam and shaft actuated by an electro-motor; and a reference is hereby made to said patent for a description of the application of said instrument and the manner of printing from the punctured sheet of paper.

The object of my present invention is to make use of air, gas, water, or other fluid as the motor for actuating the reciprocating needle-rod, whereby I am enabled to reduce the weight of the instrument, and consequently render it more convenient for use.

In the drawings, Figure 1 is a vertical section of the instrument provided with a fan-wheel for the air or other fluid to act on. Fig. 2 is an elevation of the pen-holder and section of the fan-wheel case. Fig. 3 shows the cam for reciprocating the needle-rod.

a is the pen tube or holder, tapering to a point, *b*, at its lower end, and its upper end is screwed into the socket *c* and clamped by the nut *d*. *e* is the needle-pointed rod within the tube or holder *a*, and the needle-point *f* should project slightly below the end of the point *b* when the rod *e* is at its extreme downward movement, so as to puncture the paper and be entirely within the tube at the reverse movement, in order that the pen can be moved in forming the letter or line, all substantially as set forth in the aforesaid patent.

In Figs. 1 and 2, I have shown a case, *h*, upon the socket *c*, and within this case is a fan-wheel, *i*, upon a shaft, *l*, in screw-bearings attached to the sides of said case, and secured to this shaft is a cam, *m*, that acts upon the stock *n* at the upper end of the needle-rod *e*, and reciprocates said rod with more or less rapidity, according to the speed of rotation of the fan-wheel *i*. This fan-wheel may be driven by water admitted to the case *h* through the flexible tube *t* from any suitable supply, such as a connection from a street-main, or from a reservoir properly located, the fluid escaping by the pipe *v* after acting upon the wheel; or air under pressure from a compressing apparatus may be used for driving the fan-wheel; or the flexible tube *t* may be provided with a mouth-piece, so that the person using the instrument may blow into the tube and case, and thus rotate the fan-wheel.

I claim as my invention—

1. In an instrument for puncturing paper for autographic printing, a needle-pointed rod reciprocated by a device constructed substantially as described, and operated by the action of air or other fluid, as set forth.

2. In combination with the holder *a* and needle-rod *e*, the fan-wheel *i*, case *h*, shaft *l*, cam *m*, and flexible tube *t*, substantially as and for the purposes specified.

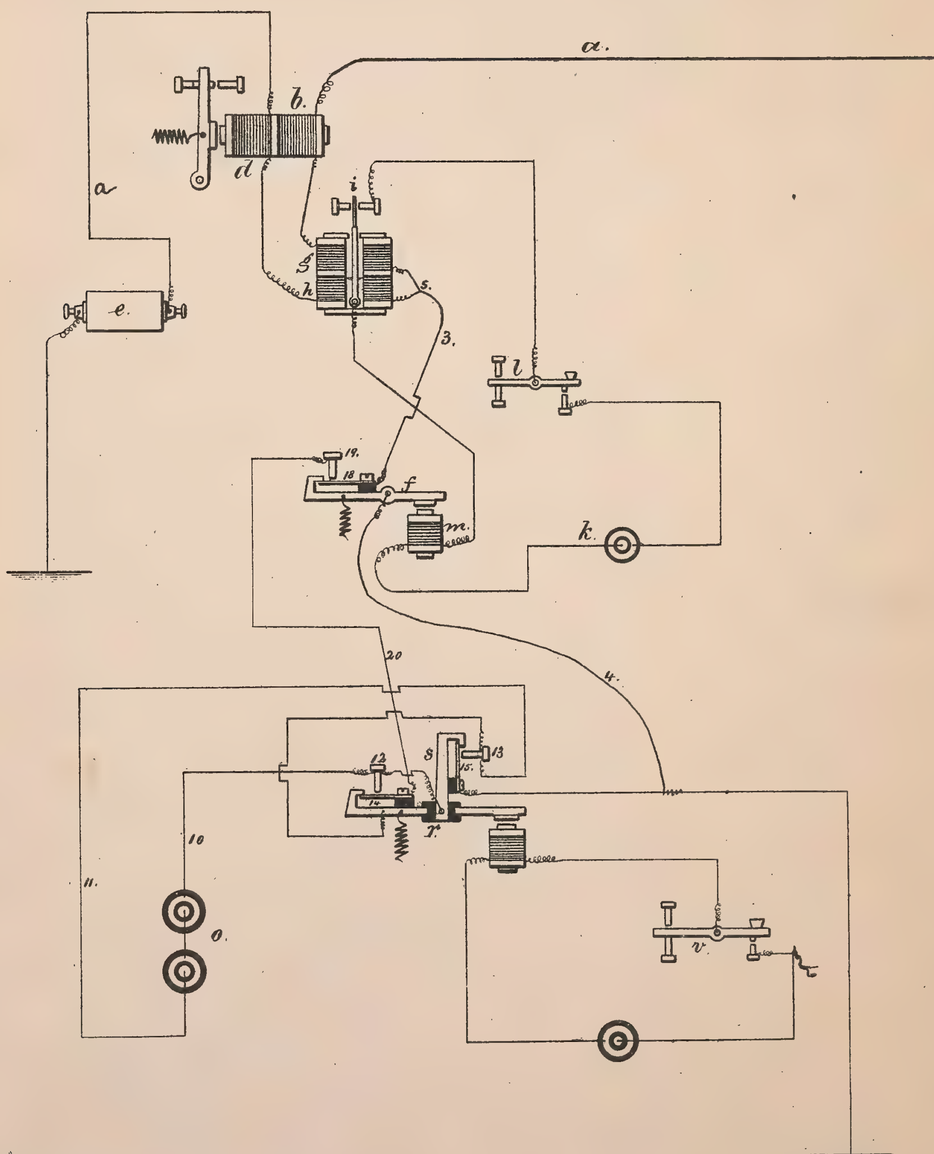
Signed by me this 3d day of February, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON.
Duplex Telegraphs.

No. 207,723. Patented Sept. 3, 1878.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison
per L. W. Serrell
Atty.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT, OF NEW YORK CITY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **207,723,** dated September 3, 1878; application filed September 1, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

Where two persons are sending and two receiving, one at each end, the entire line is sometimes deranged by a signal from one of the receivers to repeat. My invention is made to allow either party that is receiving to interrupt the person sending to him, so that he is thereby warned to repeat, and that without interfering with the other message that is being sent or received.

In the diagram drawing, *a* is the line; *b*, the receiving relay-instrument. *d* is a helix around the same core as *b;* and this helix is in a circuit passing to the artificial line and rheostat *e*, and this rheostat is to be adjusted to equal the line, so that the pulsation from the sending-station, acting in reverse in the helices *b* and *d*, produces no magnetizing effect in the core, but the pulsation from the distant station, passing along *a*, acts in *b*, unbalanced, and either produces the sound by the armature-magnet or else works a local circuit and sounder. The pulsation received from the distant station passes by 3, *f*, and 4 to the earth-connection.

The lever *f* is operated to give the pulsations that are sent upon the line, and these pulsations divide at 5, passing equally through the helices *g* and *h*, thence through the helices *b* and *d* aforesaid.

The helices *g* and *h* are of a differential polarized relay, the tongue or polarized armature-lever *i* of which forms a circuit-breaker in the local circuit *k l m*, and in this circuit the key *l* acts to open or close the circuit, and, by the electro-magnet *m*, operate the lever *f* and send the pulsations upon the line.

The main battery *o* is connected by wires 10 11 to closing-points 12 13, and the reversing-lever *r* has springs 14 15 and an insulated arm, *s*. When the key *l* is operated the lever *f* closes 18 and 19, and with the lever *r* in the position shown the circuit is closed by 10 12 *s* 15 to the ground, there dividing, part returning through *e d h* to 3, part going to distant station, thence by *a b g* to 3, whence the united currents pass by 3, 18, 19, 20, 14, *r*, 13, and 11 to the battery. By these connections the pulsations are sent to the distant station and received there in a similar instrument. It will be apparent that at the sending-station the current divides at 5, and, passing through both *g* and *h*, the polarized armature will be retained in the normal position, with the circuit of *k l m* closed, regardless of whether the current sent is reversed or not; but the current from the distant station only acts in *g;* hence the polarized tongue is changed by the reversal of the battery-connection at the distant station, so that if the receiver closes the key *v* he does not interfere with the party sending by the key *l* from his own station, but, the battery-connection being reversed, the differential relay at the distant station is changed by the change of polarity in *g*, and the party sending the message is warned to repeat by the fact that his own magnet *m* does not work, because the polarized tongue has broken the circuit of the magnet *m*, and it will not respond to his key *l*. It is to be remarked that the receiving-operator only closes his key *v* sufficiently long to give the signal, and then releases it, so that the parts resume their normal condition to allow of the message being again sent to him. The reversal of the polarity at the sending-station does not change the balanced condition of *b d*, nor make any difference in the action at the distant station, because that current sent is operative in *b* at the receiving-station, whether of one polarity or the other.

I do not herein claim the construction or arrangement of the reversing lever or key *r*, except in combination with other portions of the apparatus, as hereinafter specified, as the same is fully described in another application of even date herewith, and designated as Case 99.

I claim as my invention—

The differential polarized relay-magnet *g h* and local circuit containing the key *l*, armature-lever *i*, and magnet *m*, in combination with the reversing-key *r* and circuit-connections, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

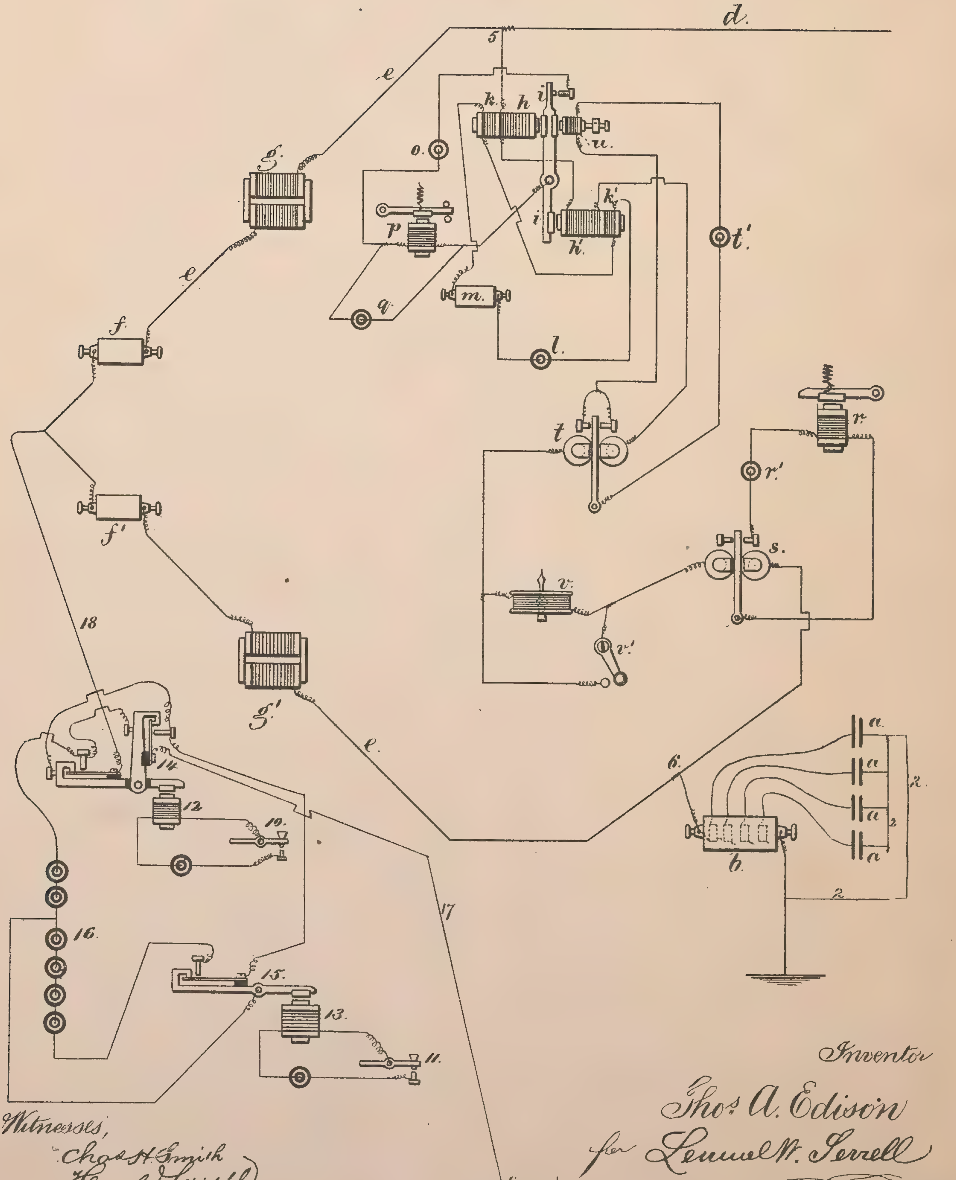
THOS. A. EDISON.

Witnesses:

CHAS. H. SMITH,
GEO. T. PINCKNEY.

T. A. EDISON.
Duplex Telegraph.

No. 207,724. Patented Sept. 3, 1878.



Witnesses,
Chas H. Smith
Harold Serrell

Inventor
Thos. A. Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **207,724**, dated September 3, 1878; application filed December 28, 1874.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification:

Duplex telegraphs have been made with an artificial line connected to a bridge, and a resistance and condensers have been used in such artificial line; but the artificial line does not properly represent the telegraph-line, and there are inaccuracies in the action of the artificial line arising from the fact that the energy of the current sent is greatest near the sending-station and diminishes toward the receiving-station, and the reaction or static discharge is in the same proportion, the last portion thereof being the weakest; but in the artificial line the condensers discharge so nearly simultaneously that the static discharge from them does not properly balance the static discharge from the line.

The first portion of my present invention relates to the arrangement of the condensers and rheostats composing the artificial line.

The second portion of my invention relates to the combination of a retractile magnet with the armature of the receiving-magnet, the retractile magnet being so arranged as to release its action upon the said armature at the moment of the reversal of polarity of the main battery.

In carrying out the first part of my invention, instead of making use of a single condenser having a static capacity equivalent to that of the line, as has heretofore been the practice, I employ two or more separate condensers, the number depending upon the length of the line, and having an aggregate capacity equal to that of the single condenser heretofore employed.

It is well known that the static capacity, and consequently the charge of a long line, is greatest at the end adjacent to the battery, and decreases progressively from thence to the distant end, where it becomes *nil*. When, therefore, the line is discharged by disconnecting the battery, and connecting the same end to the earth, as in duplex transmission, the initial portion of the discharge is the most powerful, after which it decreases rapidly until it becomes imperceptible, for the reason that the portion of the charge contained in the distant portion of the line is not only proportionately smaller in amount, but also has a greater length of line or resistance to pass through to reach the point of discharge.

In order to produce a corresponding action in the artificial line, I employ a suitable number of separate condensers, *a a*, of progressively-increasing capacity, and of which the aggregate capacity is equal to that of the line. For example, suppose the capacity of the line is represented by 1,600, and four condensers were employed, as shown in the drawing, then the capacities of the respective condensers should be approximately 700, 500, 300, and 100. Between the several condensers and the line I also place rheostats *b b*, so adjusted and arranged that the condensers will be charged and discharged through resistances having to each other the relation of the numbers 1, 2, 3, and 4. When arranged on this principle the charging and discharging of the group of condensers *a a* will correspond with that of the line with sufficient accuracy for all practical purposes. This arrangement is applicable to all descriptions of duplex and multiple telegraphs.

The line *d*, wires *e e*, and connections from 5 to 6 form the bridge, and in the bridge-wires *e* are the rheostats *f f'* and electro-magnets *g g'*, and these electro-magnets neutralize the effects of the secondary currents from the receiving-magnets placed between 5 and 6 in the bridge, which, were it not for these electro-magnets and their neutralizing discharge, would circulate in the circuit formed by *e e* 5 6, and cause the relay-magnets in such circuits to stick, or respond too slowly. The rheostats *f f'* should be adjusted to properly regulate the resistance in *e e*.

The double-coiled receiving-magnet *h h'* is worked by increased or decreased current from the distant station. I find that it is better to divide this magnet into two parts, so as to use short spools and obtain as great or greater power, with less resistance, than would arise if the whole of the wire were coiled on one core, and these magnets *h h'* are at opposite sides of the armature-lever *i* and its fulcrum, so as to act in unison.

There is a second coil or spool, k k', to each core of the electro-magnets h h' in a local circuit, with a battery, l, and adjustable rheostat, m. The action of these coils is so adjusted by the rheostat that any currents that may leak into the line from the ground by imperfect insulation or otherwise are neutralized, and for this purpose the poles of the battery are to be properly connected, according to the character of the current leaking to the line. Thereby the line is better adapted to quadruplex transmission, because if the action of the current from the distant station is varied by its strength being increased by an addition of the same polarity, or lessened by a leakage of opposite polarity, the effect is neutralized by the local circuit from l, and the coils k k' acting upon the cores of the magnets h h' in a way to balance the effect on such cores by the leakages of the line.

The armature-lever i operates the local circuit of the battery o, and in this is the sounder p, for receiving from the distant station, and to this sounder is also connected the local circuit q, as explained in one of my previous applications for patents. In this case the sounder p responds according to the pulsations from the distant station, whether the same is a rise or decrease of tension; so, also, the sounder r in the local circuit from r' is operated by the polarized magnet s, according to the reversal of the currents from the sending-station, as before explained in my previous application.

In the circuit between 5 and 6 is placed a second polarized magnet, t, and its armature is operated only by the reversal of the current, and it opens and closes the circuit from t' through the retractile magnet u. This magnet u takes the place of a spring to draw back the armature i. It is known that when a reversal of the current takes place in an electro-magnet there is a moment of neutralization or no magnetism; hence at that moment a spring, if used, pulls the armature back, and produces a false operation in the quadruplex telegraph especially. The tongue of the polarized magnet t in the circuit of the permanent retractile magnet u, being moved by reversal of current on the main line, opens the circuit of u momentarily, and then closes the same, so as to neutralize as far as possible the risk of a false movement of i by breaking the circuit of u at the instant of reversing the polarity.

The galvanometer at v and a switch, v', to place it in circuit are useful in the adjustment of the rheostats and the balancing of the electric energies. When the resistance of the artificial line is equal to that of the main line there will not be any current through the bridge; hence the galvanometer will remain uninfluenced.

The finger-keys 10 and 11 are employed to open and close local circuits to the electro-magnets 12 and 13, and these in turn operate the circuit-preserving keys 14 and 15, that are connected with the two-part battery 16, earth-wire 17, and line-wire 18, in a manner similar to that heretofore employed by me, so that one operator's message is indicated by the reversal of the polarity of the current, and the others by producing a rise and fall in the tension of the current sent.

The particular transmitting devices shown are not herein claimed, being included in my application designated as Case 99, filed September 1, 1874.

I claim as my invention—

1. In a duplex telegraph, an artificial line provided with two or more condensers of varying capacity, and a like number of rheostats of varying resistance, for regulating the charge and discharge of the same to correspond with that of the main line, substantially as and for the purpose specified.

2. The retractile magnet u, combined with the magnet h and polarized magnet t, that acts to momentarily break the circuit of u when the reversal of polarity takes place, substantially as set forth.

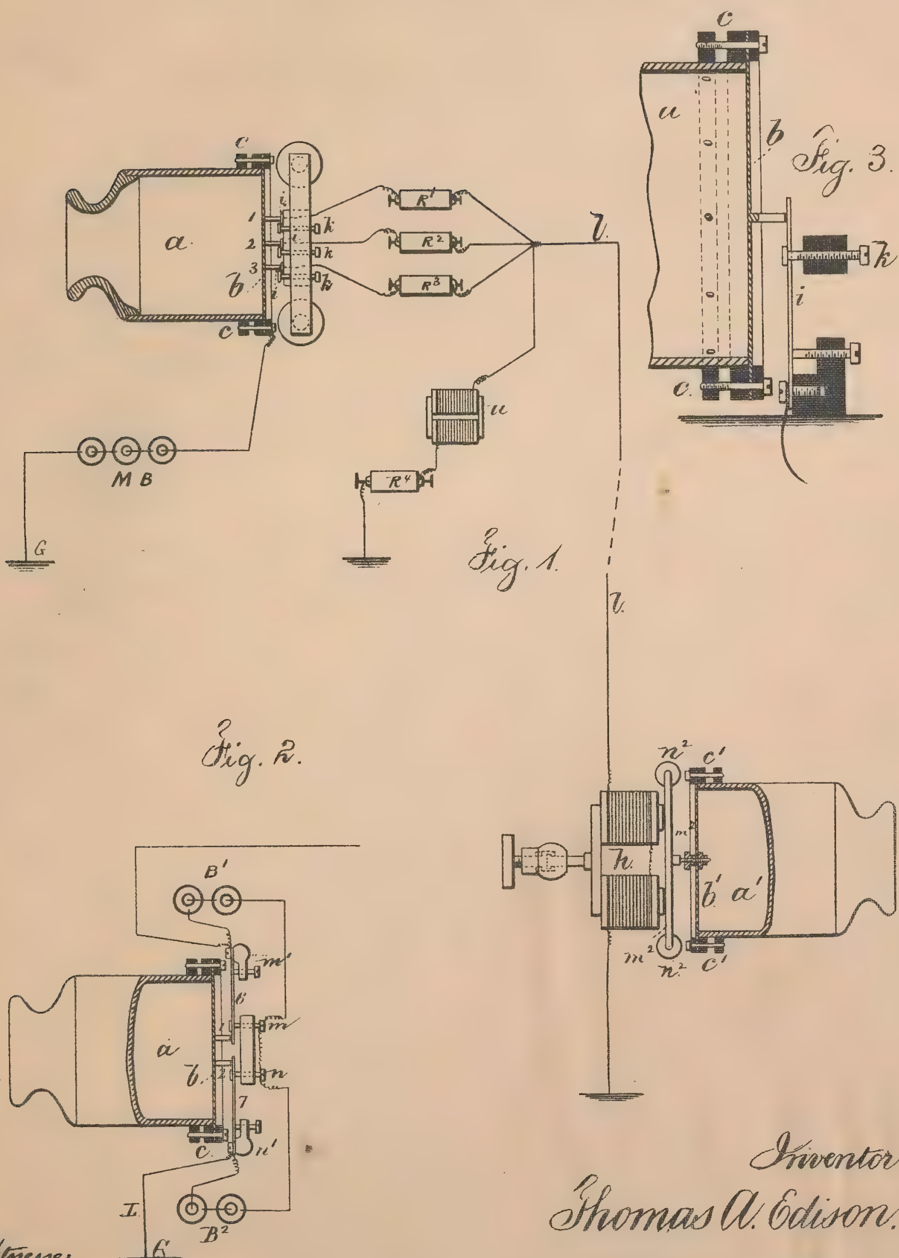
Signed by me this 14th day of December, A. D. 1874.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.

T. A. EDISON
Speaking-Telephone.

No. 208,299. Patented Sept. 24, 1878.



Witnesses
Chas H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEPHONES.

Specification forming part of Letters Patent No. **208,299**, dated September 24, 1878; application filed July 20, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification:

In acoustic telegraph-instruments there is comparatively little difficulty in transmitting musical tones, because the pulsations vary in number per second, and the distant reed or other receiving device that is of the same tone responds; but in speaking the tones of the voice are often in the same musical key, and hence there is difficulty in obtaining a clear response to the words spoken.

My invention relates to the transmission of varying strengths of current, according to the strength of the tone, and to a certain extent regardless of the musical key; and at the receiving-instrument a corresponding tympan receives the proper movement to produce a corresponding sound, through the agency of an electro-magnet operating on the same.

In the drawing, Figure 1 is a plan view of the transmitting and receiving devices, partially in section. Fig. 2 is a sectional view of a modification in the transmitting device; and Fig. 3 is a section, in larger size, of a portion of the transmitting apparatus.

The transmitting device consists of the resonant case *a*, with a tympan, *b*, over the end, the same being, by preference, a sheet of metal; and *c* are tightening rings and screws, whereby the tension of the tympan is regulated. A similar resonant case, *a′*, tympan *b′*, and tighteners *c′* are provided at the receiving-station, and the two should be made of the same, or nearly the same, character throughout, in order that the resonant conditions may correspond.

There are two or more contact-points at the transmitting-station. In Fig. 2, I have shown two, numbered 1 and 2; and in Fig. 1 there are three, numbered 1, 2, 3. These contact-points are so constructed and arranged in the electric circuit that when the voice acts in the resonant case and vibrates the tympan more or less, according to the strength, volume, or tone of the voice, the electrical condition of the line will be correspondingly influenced—that is to say, a feeble tone will produce but a feeble electrical response on the line, and the reverse; hence the electro-magnet *h*, acting at the receiving end, will exert a power to vibrate the tympan *b′* proportionate to the voice-power at the transmitting-station.

In Fig. 1 one pole of the main battery M B is connected to the earth, and the other to the tympan *b*. The line *l* is connected, through the rheostats R^1, R^2, and R^3, to the respective contact-springs *i*, and these press toward the points 1 2 3, respectively, but are withdrawn by the disk-pointed screws *k*, so as to be in proper proximity to the respective points. The point 2 closes the circuit, through R^2, with the smallest vibration of the tympan. The rheostat R^2 is of the greatest resistance, and hence but feeble pulsations pass to the line.

When the amplitude of vibration is increased by the strength of the sound, the circuit is closed, through R^1, by 1, and this rheostat is adjusted to offer less resistance; hence a stronger current passes to the line, and when the contact at 3 is closed the strongest current is sent on the line, because R^3 offers but little resistance. By this device the current is proportioned to the volume of sound acting upon the tympan of the resonant case, and the pulsations of that current respond to the vibrations of the tympan. Hence the electric pulsations become the reflex of the voice, and act in the distant magnet and upon the distant tympan to reproduce the same sounds. The number of contact-points and rheostats may be increased, if desired.

The electro-magnet helix *u*, rheostat R^4, and ground-connection serve to neutralize the static charge and discharge of the line and self-induction of the instruments. At the receiving-station, the armature m^2 is a spring-bar secured in standards n^2 at each end, and it is connected adjustably to the center of the diaphragm, and it vibrates by the action of the electro-magnet *h*, placed in front of it, and through the helix of this magnet the current passes from the line to the earth, or the reverse. This armature m^2 responds with greater rapidity and delicacy than a swinging armature, and

there is no risk of its movement being so great as to allow it to touch the cores of the electro-magnet and adhere to them.

In Fig. 2, the battery B^1 is connected between the adjusting-screw m and the standard m^1 of the spring 6, and the battery B^2 is in a circuit between the adjusting-screw n and the standard n^1 of the spring 7; and the screws m and n are insulated, but connected in the metallic circuit passing through the standards m^1 n^1, the batteries, and the line L to the ground G. It will now be evident that when at rest the respective batteries are short-circuited through 6 m and 7 n, and hence do not act upon the line; but when the tympan is vibrated the contact of 1 or 2 with its adjusting-screw is broken, and the battery-current passes to the line; and if the contact of both be simultaneously broken, the line-current is from both batteries and correspondingly pulsated. By this construction of circuit-closer the quantity of battery-power is increased in proportion to the increase of the power or volume of the voice in speaking.

Several of these contact-points and batteries may be used instead of two.

As I have shown in my previous application, No. 130, filed April 27, 1877, a diaphragm with means for regulating the tension thereof, no claim is herein made to such device.

In my application No. 130, filed April 27, 1877, I have shown a means for producing a rise and fall of electric tension by the vibrations of a diaphragm; and in my application No. 145, filed December 13, 1877, I have shown an armature-plate, an electro-magnet for the same, and a closed circuit to the source of undulatory electric energy. It is therefore to be distinctly understood that I do not, in this present application, make any claim to any such devices, but limit my claim hereunder to devices that are not shown in either of said applications.

I claim as my invention—

1. The combination, with the tympan arranged to respond to the human voice, of two or more contact-points operated by such tympan and the electric circuits, substantially as specified, whereby the current passing upon the line is pulsated in unison with the vibrations of the tympan and its volume proportionately increased or decreased, substantially as set forth.

2. The combination, with the resonant case and tympan, of two or more contact-points and rheostats, adjusted substantially as specified, to regulate the strength of the electric pulsations passing upon the line, as set forth.

3. The combination, with the diaphragm and resonant tube, of an electro-magnet and a spring-armature that is supported at both ends, substantially as set forth.

Signed by me this 16th day of July, A. D. 1877.

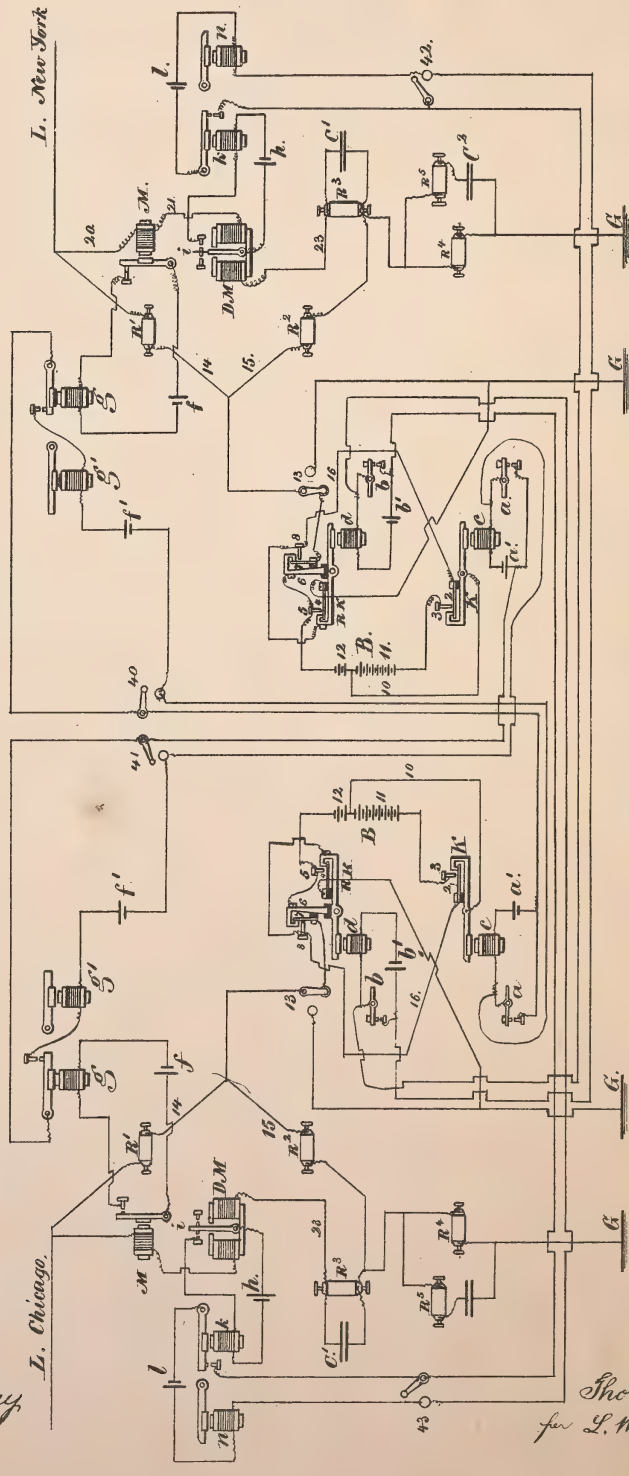
THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.

Quadruplex Telegraph Repeaters.

No. 209,241. Patented Oct. 22, 1878.



Witnesses,

Chas. H. Smith

Geo. T. Pinckney

Inventor

Thos. A. Edison

per L. W. Serrell att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

Hôtel Continental
3, Rue Castiglione
PARIS

Adresse Télégraphique :
CONTENTAL-PARIS

Paris le ....

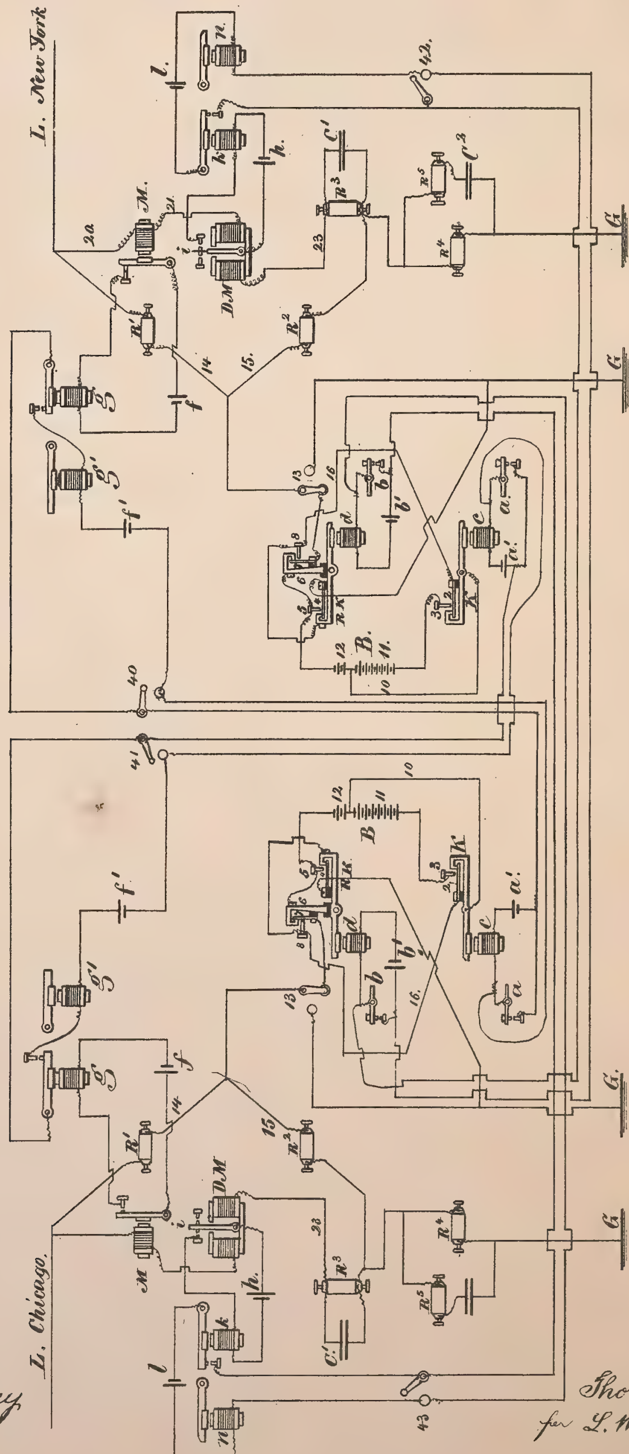
Pat- applied for Dec 24-77
granted Feb 19-78.

See 200,521
201,760
227,679

PEQUEREAU - PARIS

T. A. EDISON.
Quadruplex Telegraph Repeaters.

No. 209,241. Patented Oct. 22, 1878.



Witnesses,
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison
per L. W. Serrell
att'y

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

T. A. EDISON.
Quadruplex Telegraph Repeaters.

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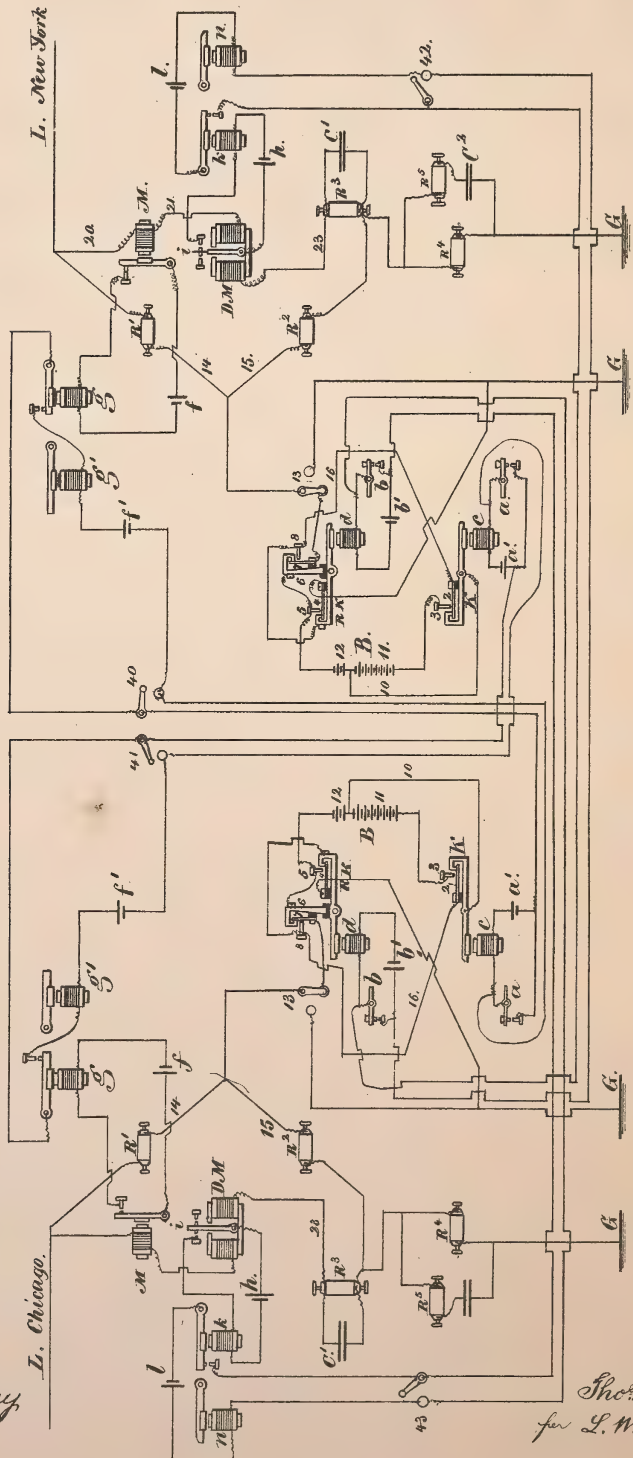


Witnesses,
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thos. A. Edison
per L. W. Serrell
atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

Phonograph

Patents on Burnishing surface of wax blanks

Feed & return mechanism

Process for making blanks

2 Patent - for Blanks

Duplicating Blanks,

Phonograph

2 Machine for making Blanks

Method of preparing recording surfaces

Phonograph Recorder.

5 Method of Recording & Reproducing sound -

Reproducers

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN VOCAL ENGINES.

Specification forming part of Letters Patent No. **210,767**, dated December 10, 1878; application filed November 27, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, Middlesex county, State of New Jersey, have invented certain new and useful Improvements in Vocal Engines; and do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

The object of my invention is to transform the vibrations of a diaphragm or other body capable of being set in vibration by sound-waves into continuous rotation of a shaft, to act as a prime motor for various light mechanisms.

My invention consists in the combination, with a diaphragm sensitive to sound-waves, of a shaft between centers having a fly-wheel attached, and combining the diaphragm therewith by a friction-clutch, which, when reciprocated by the vibration of the diaphragm, acts upon a shaft so as to continuously rotate the same when the diaphragm is actuated by sound-waves.

Figure 1 is a front view of my apparatus. Figs. 2 and 3 are side views of the same.

In Fig. 1, C is the diaphragm, of any convenient material, which is secured to the frame A by the ring D and screws X X. B is a mouth-piece for concentrating the air-waves upon the diaphragm. F is a cork secured to the center of the diaphragm. 2 is a rubber tube, into which a pin is secured. This pin connects the rubber with the reciprocating lever G, whose fulcrum is upon the shaft 3.

P is a click or pawl resting upon the wheel H, and pressed against its surface by the spring O. K is another click, secured to the upright M, which serves to prevent a backward motion of the shaft. E is a fly-wheel, for storing, by momentum, the intermittent power, and thus keeping the shaft in continuous rotation. The shaft 3 runs in centers between the uprights M and N. The whole is secured to the base W.

The action is as follows: When the mouth is placed in proximity to the mouth-piece B, and several words are spoken, or a musical note given, the sound-waves, striking the diaphragm, set it in vibration. This, in turn, reciprocates the lever G, causing the shaft to be carried forward a small distance at every vibration, and the momentum of the fly-wheel transforms these minute impulses into continuous rotation of the shaft. A small grooved pulley, 4, Fig. 1, is attached to the shaft, in the groove of which a continuous thread or band may pass to any light mechanism, and thus give motion.

I do not wish to confine myself to any particular mechanism for transforming the vibratory motion of the diaphragm into continuous motion, as a ratchet-wheel and click and many other well-known mechanical equivalents may be used. Neither do I wish to confine myself to a pulley and cord for connecting the prime mover to the apparatus to be set in motion, as a worm and wheel or toothed wheel or friction-wheel may be substituted instead.

A large cone may be inserted in the mouth-piece B, for collecting extraneous sounds and causing them to move the diaphragm.

This apparatus is useful for giving motion to clocks and other small apparatus requiring minute power.

I claim as my invention—

A vocal engine consisting of a diaphragm or other body capable of being set in motion by sound-waves, a shaft, and reciprocating mechanism, substantially as and in the manner set forth.

THOMAS A. EDISON.

Witnesses:
WM. CARMAN,
CHAS. BATCHELOR.

T. A. EDISON
Vocal Engine.

No. 210,767. Patented Dec. 10, 1878.

Fig. 1.

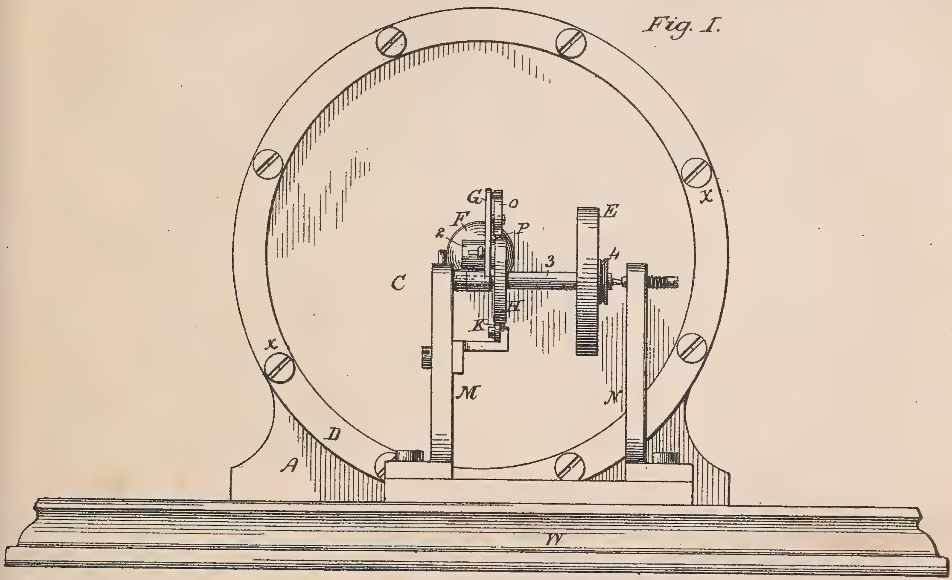


Fig. 2.

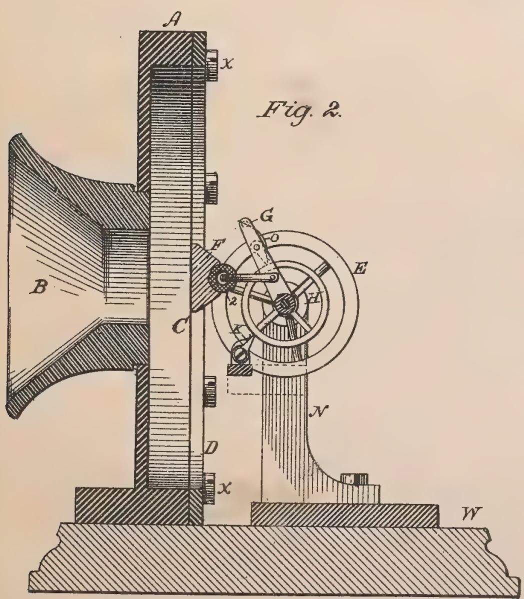
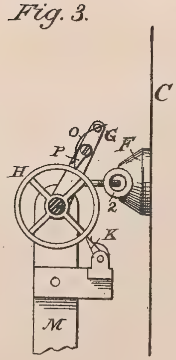


Fig. 3.



Witnesses
C Clarence Poole
U. H. Painter.

Inventor:
Thomas A Edison

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR OF ONE-HALF HIS RIGHT TO GEORGE B. PRESCOTT.

IMPROVEMENT IN QUADRUPLEX-TELEGRAPH REPEATERS.

Specification forming part of Letters Patent No. **209,241**, dated October 22, 1878; application filed March 23, 1875.

CASE No. 113.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Quadruplex Telegraphs, of which the following is a specification:

The object of this invention is to repeat from one quadruplex circuit into another quadruplex circuit.

In my present invention I make use of two quadruplex circuits, in which the signals are made by rise and fall of tension in one relay-magnet, and by change of polarity in the other relay-magnet, which is polarized. The modes of connecting and operating have been fully set forth in applications heretofore made by me.

The present improvement relates to the connections from one quadruplex telegraph to another, whereby the circuits work into and operate each other, so that the messages are repeated automatically in one circuit by the receiving-instrument of the other circuit, instead of the finger-key being operated by hand.

The entire apparatus and connections for repeating, as aforesaid, are shown in the diagram, which, although it appears complicated, is very simple. One line, L, comes, for instance, from New York to one set of instruments at an intermediate station—say Buffalo—and the other line, L, extends to the distant instruments—say at Chicago—in the other direction.

The keys and instruments are duplicated and exactly the same, only there are two distinct sets of instruments.

Suppose that a message over the wire L from New York acts by rise and fall of tension in the relay-magnet M, and that this message is repeated into the sounder or receiving-instrument g'. If the switch 40 in the local circuit of the battery f' is closed, the message goes no farther; but if the switch 40 is open the circuit of the battery f' extends to the electro-magnet c, the switch of the key a being open. Thereby the message received at M on one line is repeated by c and K into the next line. So, in like manner, the message received from New York in the differential magnet D M and repeated in the sounder n will go no farther if the switch 42 is closed; but if the switch 42 is open the message will be repeated to Chicago at the key b by the magnet d and key R K, that reverses the circuit in the same manner as if the finger-key b were operated.

Of course, by opening the switch 41 the message coming over the line L from Chicago and received in M will be repeated to New York, and the same thing will occur in relation to the message received in D M from Chicago if the switch 43 is closed. Thus one or more messages may be automatically repeated in long lines without interfering with the working of the other portions of the quadruplex instruments in either direction from the intermediate station.

In an application for Letters Patent filed by me September 4, 1874, Case 99, circuit-preserving keys for changing the polarity of the current and for increasing or decreasing the electric tension, like those shown in this application, and instruments for responding to the pulsations sent by these keys are shown. I therefore do not herein lay any claim to the same.

What I claim is—

1. In combination with two main-line circuits, each capable of quadruplex operation, the repeating-magnets, local circuits, switches, and connections, arranged substantially as set forth, so that either message may be repeated independently of other messages, substantially as set forth.

2. The combination, with the receiving-sounders in one line, of repeating-instruments, local circuits and switches, and transmitting-instruments in the other line, arranged and operating substantially as and for the purposes set forth.

Signed by me this 24th day of February, A. D. 1875.

THOMAS A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
GEO. D. WALKER.

2 Sheets—Sheet 1.

T. A. EDISON.
Automatic-Telegraph.

No. 213,554. Patented Mar. 25, 1879.

Fig. 2.

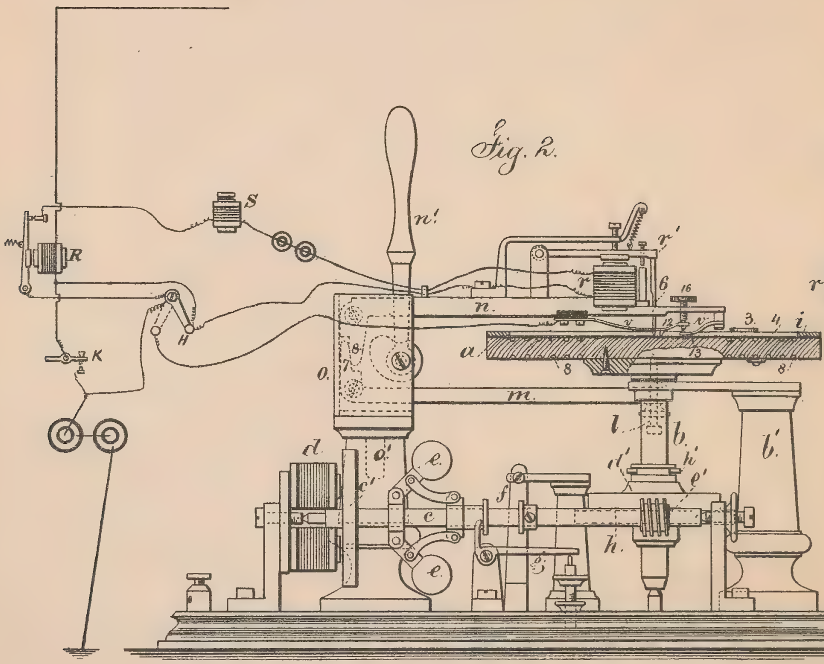


Fig. 3.

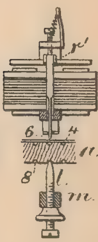
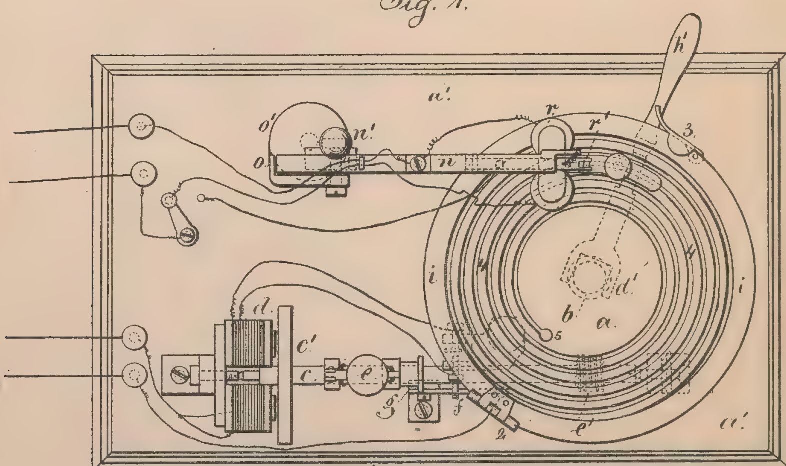


Fig. 1.



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.
per Lemuel W. Serrell
atty.

2 Sheets—Sheet 2.

T. A. EDISON.
Automatic-Telegraph.

No. 213,554. **Patented Mar. 25, 1879.**

Fig. 5.

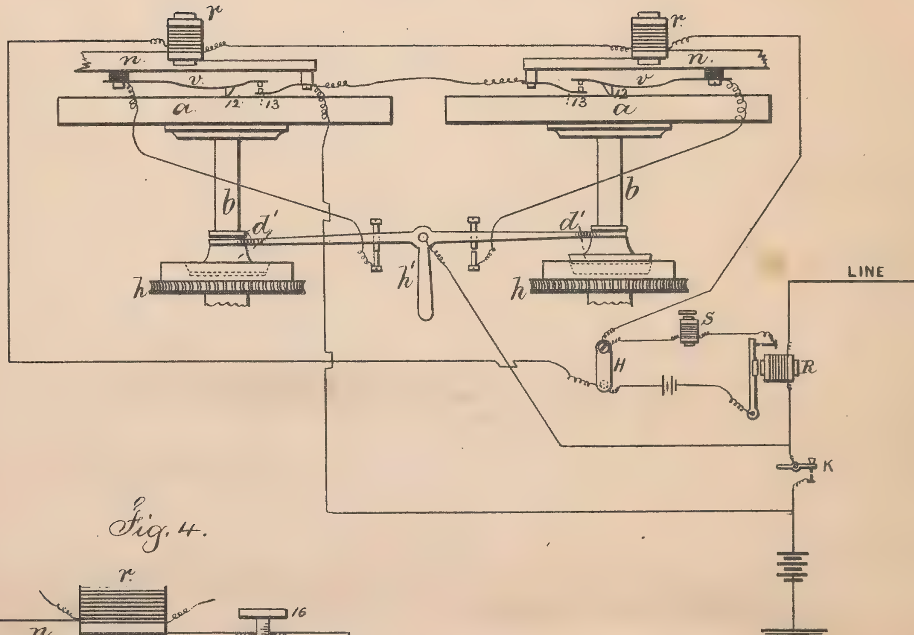


Fig. 4.

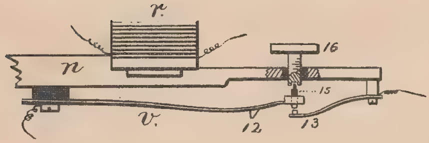
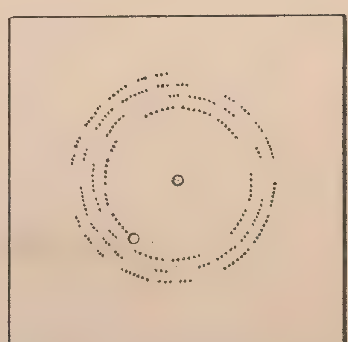


Fig. 6.



Witnesses
Chas H Smith
Geo. T. Pinckney

Inventor
Thos A. Edison
per Lemuel W. Serrell atty

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN AUTOMATIC TELEGRAPHS.

Specification forming part of Letters Patent No. **213,554**, dated March 25, 1879; application filed March 26, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification:

The object of this invention is to indent upon a sheet of paper the characters received from a distant station, or the characters transmitted from the same station, and to use such sheet of paper to transmit the same message, thus providing an automatic device for transmitting the same message more than once from one station to different stations, and for retransmitting the message automatically where it has to pass through several offices to reach its destination.

In the drawings, Figure 1 is a plan of the instrument. Fig. 2 is a side view with the indenting-plate in section; and Fig. 3 is a section of part of the indenting-plate and pin.

In chemical telegraphs a sheet of paper has been clamped to a disk, and the stylus resting upon such paper has been moved gradually toward or from the center of the disk by a volute groove in the surface of the disk itself or in a separate plate.

I make use of a volute groove in a disk or plate; but the first part of my invention relates to the disk or plate with volute groove or channel in the under surface and the guiding-point below such plate, while the point that operates upon the paper is above that plate.

The disk or plate *a* is mounted upon the vertical shaft *b*, sustained by the standard *b′* and bed *a′*. Any suitable motor is applied to revolve the shaft *b* and plate *a*.

I have shown an electric engine consisting of the shaft *c*, armature *c′*, stationary magnets *d*, governor-balls *e*, circuit-breaker or commutator *f*, and lever-arm *g*, operated upon by the governor to open or close the local circuit to the magnets *d*, according to the speed of the engine, and thereby obtain uniformity. This electric engine is similar to that shown in my Patent No. 131,343.

The worm *e′* upon the shaft *c* serves to rotate the wheel *h* upon the shaft *b*, and there is a friction-clutch, *d′*, and lever *h′*, by means of which the wheel *h* is connected with or disconnected from the shaft *b*.

Upon the plate *a* is a clamping-frame, *i*, preferably hinged at one side, 2, and provided with a swinging catch, 3, at the other side. The paper to receive the message is laid upon this plate *a*, and held by the frame *i′* around its edges.

There are to be guide-marks upon the paper and also upon the disk *a*, so that the paper can be correctly positioned upon the disk in the first instance, and replaced absolutely correct when required. For this purpose it is preferable to perforate the paper at the center and at a point corresponding to the hole 5.

The volute groove 8 is upon the bottom of the plate *a*, and in it is the point of the pin *l*, that is at the end of the arm *m*, and above the disk *a* and paper is the marking-point 6 at the end of the arm *n*.

These arms *m* and *n* are hinged to a stock, *o*, upon a vertical standard, *o′*, and there is a vertical pivot upon which the stock *o* and the lever-arms *m n* swing horizontally. The arms *m n* have right-angled toes, as seen by dotted lines at 7 and 8, and the weight of the arm *n* is greater than that of *m*, and hence the point *l* is raised up into the volute groove, and the point 6 rests upon the paper. The lever *n′* acts to raise the point 6 off the paper by pressing the lever-arm *m* downwardly when it is desired to move both points away from the paper.

The marking-point 6 is made to indent the paper by the action of the electro-magnet *r* and its armature-lever *r′*, and thereby produce Morse or other characters by pressing the paper down into the groove 4 of the disk *a*, and this electro-magnet *r* is either in the main line or (by preference) in a local circuit.

In Fig. 2 these circuit connections are illustrated. The relay-magnet R operates by its armature the local circuit to the electro-magnet *r*, and in this is placed the sounder *s*.

The operator at the receiving-station closes the switch H of his key K, and the sending operator opens his switch.

When the instrument is employed to translate or repeat the message into another circuit the delicate insulated spring circuit-closer *t*,

tracing-point 12, and contact-point 13 are made use of, and these are placed in the circuit into which the message is to be sent in order that the tracer 12 may lift the spring v and break the circuit when resting on the portion of paper that is not indented, and when the indented portion is beneath said point the spring closes the contact at 13, and the message is sent to the distant station.

The arrangement of circuits shown in Fig. 2 is convenient. In this the movement of the switch H to the dotted positions causes the main-line circuit to pass through the insulated spring circuit-closer v, point 13, arm n, so that the indented paper will give motion to the circuit-closer and transmit the message previously recorded.

The spring 13 rests upon the paper, and the circuit-closing spring v, carrying the point 12, has also the screw 15 to close the circuit upon the spring 13 when the indentation passes below the point 12. This screw 16 requires to be adjusted to suit the condition of the paper or of the indentations. I therefore provide a T-head to the screw, and a turner, 16, above it, which passes through the arm n, so that the adjustment can be made while the instrument is at work, the said turner being insulated and having a notch for the T-head of the screw, as shown in Fig. 4.

There may be two disks arranged to receive their motion from the prime mover, each having a friction-clutch that is operated by a double lever, h', whereby one disk is disconnected and stopped simultaneously, or just after the other disk is put into motion, so that when one paper is full its disk may be stopped just after the other is started, so as not to drop any signals, and the paper that is full is removed and another paper substituted. The same devices are available either in receiving or in sending messages.

In the diagram, Fig. 5, the connections for this purpose are shown, and the lever h' closes the circuit through the spring circuit-closer v and contact-point 13 in the act of shifting the power from one of the disks to the other.

It will generally be preferable to make the volute grooves in square or oblong plates, so as to receive ordinary square or oblong sheets of paper. These can be more easily filed away for future reference, and contain the dates and facts desired upon the face of the paper, in the angles thereof. Fig. 6 shows one of these square blanks. The message can be read upon these blanks, or it can be repeated at any time.

In place of having only one contact spring and point, it may be preferable to have three, placed side by side and close together, so as to allow for any inaccuracy in the position of the paper, or that may result from expansion or contraction of the paper. Either one of these points passing into the indentation in the paper will close the circuit and transmit the signal. The screw 16 allows the contact-points to be adjusted to suit the paper that is in use.

A puncturing or perforating point might take the place of the indenting or embossing point.

It is obvious that many modifications may be made to produce the same result. For instance, the electric engine may be replaced by a clock-work or other motor.

The arm n might be made to rotate instead of the plate a. The underneath spiral might be dispensed with, and the spiral on top of the plate might be continued out a greater distance from the center, and the additional spiral used for giving an outward movement to the arm. The plate itself might be dispensed with, and a drum used, with grooves cut lengthwise, and the indenting-magnet moved back and forward by suitable mechanism, the paper being fed from a continuous roll.

I am aware that it is not new to record telegraph-signals by indenting or embossing paper, as that method is adopted by Morse. Neither is it new to retransmit from such characters by causing them to give motion to contact mechanism, as that is shown in the English patent granted to William Thomson and Fleming Jenkin August 25, 1860, No. 2,047. Such embossing, however, was done on narrow strips of paper.

I claim as my invention—

1. In a telegraph in which the indented or embossed message is employed for transmitting electric pulsations, the means, substantially as specified, for recording the message in a volute line upon a sheet of paper, and for following that line with the circuit-breaking device in transmitting from such record, as set forth.

2. A plate provided with a volute groove upon its surface, and means for clamping a sheet of paper thereto, in combination with an indenting or perforating point, and means for maintaining the proper position of the point over the spiral groove, substantially as set forth.

3. A telegraphic blank of paper or similar material provided with one or more perforations, in combination with the plate receiving the same, and having corresponding marks to insure accurate adjustment in the various machines, substantially as specified.

4. The combination, with a spirally-grooved or volute plate, of an arm and indenting and transmitting mechanism supported by such arm, and a second similar groove for moving such arm, substantially as set forth.

5. In combination with a rest upon the paper, a point operated by the undulations of the surface of the paper and a circuit-closer and electric circuit to a distant receiving-instrument, substantially as set forth.

6. The arms n and m, pivoted to the stock o, and turning upon a vertical pivot, in combination with the plate a, containing a volute groove, substantially as specified.

7. In combination with two revolving plates

and the indenting or transmitting mechanism connected thereto, a clutch for connecting one plate before disconnecting the other, substantially as and for the purposes set forth.

8. The combination, with an indenting-instrument, electro-magnet, and spirally-grooved plate, of a sounder in the same circuit as the indenting-magnet, substantially as set forth.

Signed by me this 3d day of February, A. D. 1877.

THOS. A. EDISON.

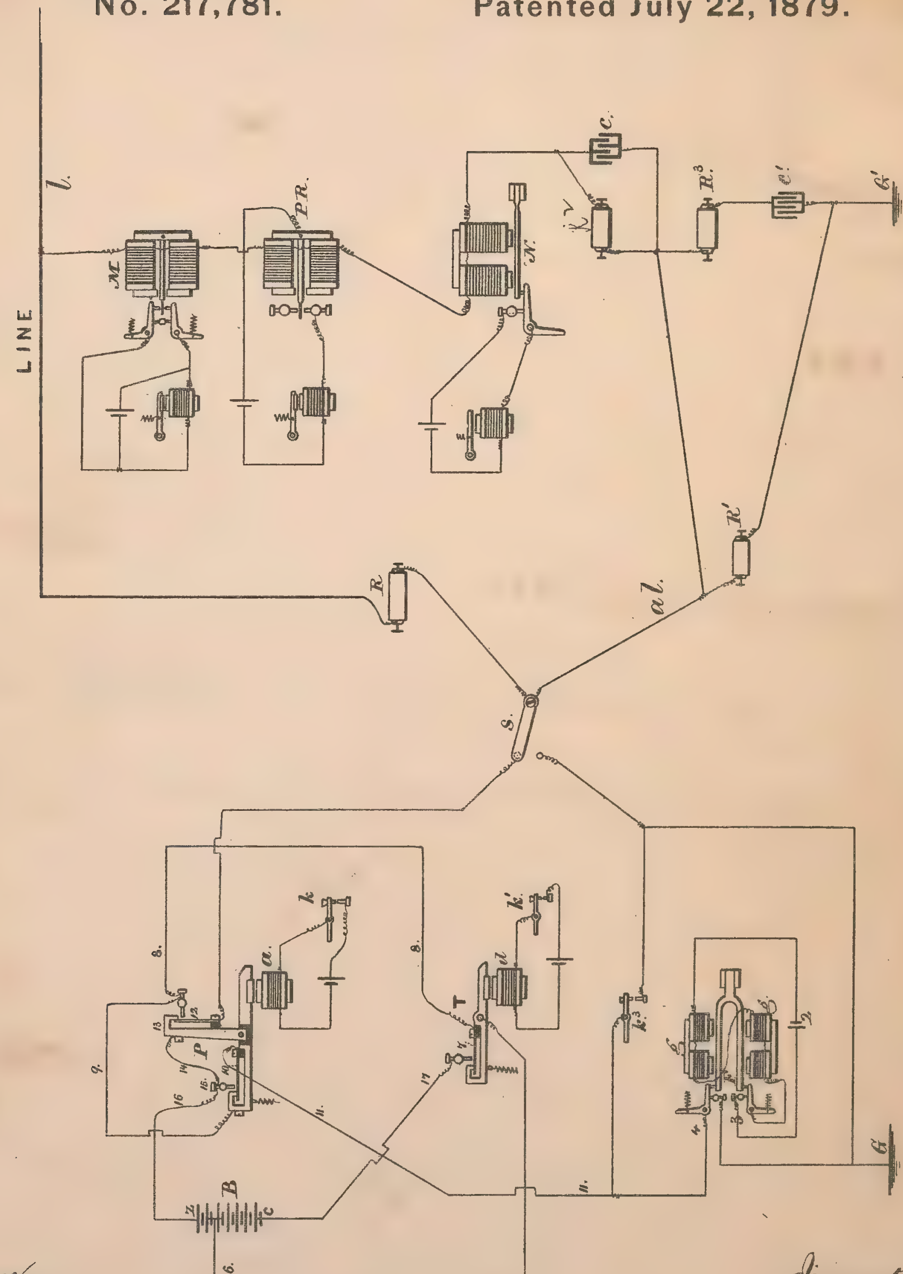
Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.

T. A. EDISON.
Sextuplex-Telegraph.

No. 217,781. Patented July 22, 1879.



Witnesses

Chas H. Smith
Harold Serrell

Inventor

Thomas A. Edison.
per Lemuel W. Serrell
att'y

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SEXTUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **217,781**, dated July 22, 1879; application filed May 14, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric Telegraphs, of which the following is a specification.

This invention is an improvement upon the telegraph known as the "quadruplex," and I designate this invention as the "sextuplex telegraph."

I have discovered that the rise and fall of tension in the line and the reversals of polarity can be effected without deranging the action of one or more reeds or other instrument vibrating according to a musical tone, and reference is made to my application No. 132, in which such vibrating instrument is shown in connection with a duplex telegraph.

In my present invention I am enabled to combine an acoustic telegraph with a quadruplex telegraph, and use twelve persons to one wire, three sending from each end and three receiving at each end, there being keys to control the rise and fall of tension and the connection and disconnection of the musical pulsations with the line, and this number will be increased if there is a second or third musical transmitter and receiver introduced into the line.

In the diagram accompanying I have represented the instruments and electrical connections at one end of line, the instruments and connections at the other end of the line being similar.

The key k opens and closes a local circuit to the electro-magnet a, that operates the circuit preserving and reversing key P, and changes the polarity of the line by connecting c of the battery B to line when k is depressed, or z to line when the key is open, or the reverse, in the manner well known in connection with quadruplex telegraphs.

The key k^1 opens and closes a local to the electro-magnet d, that operates tension-key T, and connects a part or the whole of the battery B to the line to effect a rise and fall of electric tension. In both cases these operations are performed without the main-line circuits being broken.

The reed or tuning-fork F is provided with electro-magnets g, that are connected in a local circuit to the battery 2, and serve to vibrate the reed or tuning-fork, the circuit at 3 being alternately broken and closed by the movement of the reed.

At 4 the main line from ground G is pulsated by the movement of the reed or tuning-fork F and sends its pulsations on the line, and the distant tuning-fork or reed in the bridge-wire at the distant station is pulsated accordingly. If, however, the key k^3 is closed, the main line is short-circuited around the instrument F, and the main current will cease to be pulsated at 4; hence, if the key k^3 in its normal condition is closed, signals will be given at the distant reed or tuning-fork by the circuit being broken at k^3, and the reverse, for in cases where the key k^3 is open in its normal condition the signal will be given by the interruption of the musical sound at the distant station when the key k^3 is closed.

The circuits will go over the line l and the artificial line a l preferably by the switch s, that is found to be a convenience in adjusting the receiving-instruments by connecting the line directly to the ground.

When k^1 is open, part of the battery only will be on line, the connection being from B through 6 7 8 9 10 11 to ground, (through 4 or k^3,) and returning by s 12 13 14 15 16 to z of battery.

When k^1 is closed, the whole battery B will be on line from c through 17 7 8 9 10 11, and returning as before.

When k is open, the circuit is connected through P, as before; but when k is closed the circuit is reversed at P, regardless of rise and fall of tension, the circuit being connected through T, as aforesaid, and by 8 12 to line, and returning from ground through 11, 10, 15, and 16 to z of battery.

At the transmitting-station the receiving-instruments are not influenced by the outgoing currents, because they are in the bridge-wire, the rheostats being adjusted with reference to balancing the line l and R by the artificial line R^1 to G'.

The receiving-instruments consist of the polarized relay P R, that is operated by the reversal of the polarity of the current of the magnet M, the armature of which responds to the rise and fall of tension, and the reed or telephone N, all of which may be of any known

character and respond to the respective electric conditions.

The signals may be given direct; but it is preferable to employ local circuits and sounders to each instrument.

The rheostats at R^2 R^3 serve to adjust the resistance in the bridge, and the condensers *c* *c'* serve to neutralize any static charge and discharge, the first one, *c*, serving this purpose in the bridge-wire and its local connections, and the condenser *c'* acting in the same capacity in connection with the line and ground connections.

It is to be understood that the different rheostats are to be adjusted and the resistances thereby varied according to the required conditions, as heretofore well known.

It will be obvious that the receiving-magnets may be wound with double coils, and the balance of the outgoing currents made by the differential system.

In my application No. 132, of even date herewith, I have set forth a reed operating by electro-harmonic pulsations and a relay-instrument and their appropriate transmitting-instruments; hence these are not claimed herein.

In my application No. 99 the telegraphic circuit has a key to vary the strength of current and a key to reverse the polarity, and in my application No. 125 synchronous vibrations are produced at the ends of the line by reeds or tuning-forks. These devices, therefore, are not herein claimed.

I claim as my invention—

The combination, in a telegraphic circuit, of a key to reverse the polarity of the current, a key to vary the strength of the current on the line, a vibrating reed acting to pulsate the current on the line, a key to shunt the main line and prevent the action therein of the pulsator, and three receiving-instruments in the bridge, one operated by reversal of current, the other by changes in the strength of the current, and the third by the pulsations of the current, substantially as set forth.

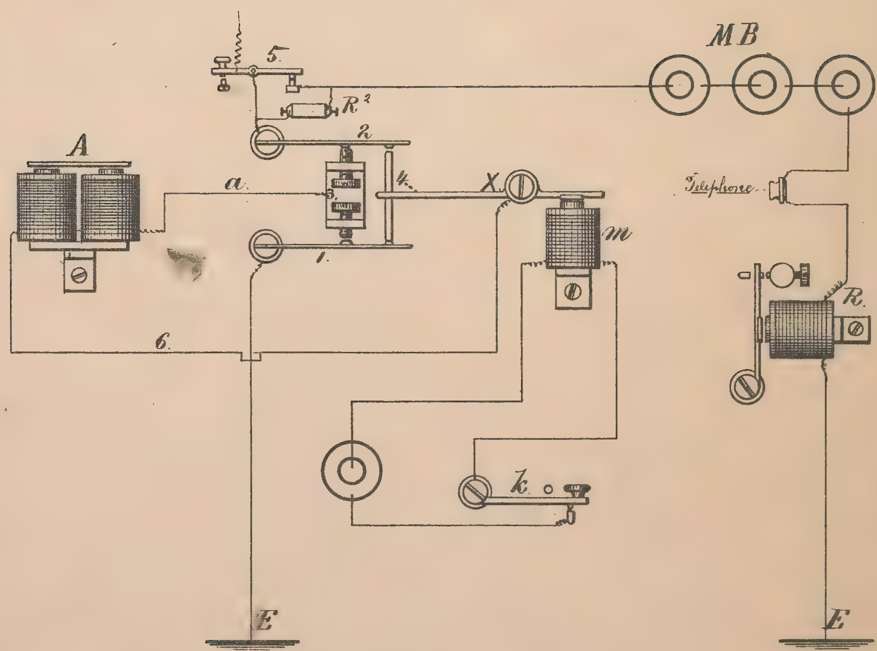
Signed by me this 8th day of May, A. D. 1877.

THOS. A. EDISON.

Witnesses:
GEO. T. PINCKNEY,
HAROLD SERRELL.

T. A. EDISON.
Duplex-Telegraphs.

No. 217,782. Patented July 22, 1879.



Witnesses
Harold Serrell
Chas H. Smith

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **217,782,** dated July 22, 1879; application filed November 14, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telegraphs, of which the following is a specification.

The object of this invention is to transmit signals from one point in a circuit to other points in the same circuit without adding battery, opening the line, or varying the resistance, in order that two series of signals may be transmitted simultaneously.

The invention consists in placing an electro-magnet in circuit, and reversing its position in the line by a reversing apparatus, so that the self-induction of the magnet, which takes place at the moment of a change in the polarity of its cores, shall weaken the constant current for an instant and thus transmit the signal.

A is the electro-magnet, placed in the main line. X is a reversing-sounder. When the local circuit, in which is the magnet *m*, is opened by the key *k*, the line passes through spring 2 to 3, thence by wire *a* to the magnet A, thence by wire 6 to the lever 4, through spring 1 to the earth.

If, now, the key *k* be closed, *m* attracts the lever, and the position of the magnet A is reversed; or, in other words, a change in polarity occurs in its cores by the current of the line passing through it in the opposite direction.

The current from the line passes through spring 2 to lever 4, thence by wire 6 to A, thence by wire *a* to 3, thence through spring 1 to the earth. Although there is a constant current circulating in the line from the main battery, M B, at the moment of reversing the magnet, the powerful induction-current from A is sufficient to neutralize it for an instant. This slight opening, although scarcely affecting the relay R, becomes audible on inserting a telephone-receiver at any point in the line.

If a key, 5, be inserted in the line, and shunted with a resistance-coil, R^2, of, say, one thousand ohms, the throwing in and out of this coil by the key will cause the relay R to work, and, owing to the form of the wave, will not affect, to a perceptible degree, the telephone-receiver; hence two series of signals may be transmitted simultaneously in various directions over a single wire. Of course several stations may be placed on one circuit.

I will mention that a shunted condenser or secondary battery may replace the magnet A.

It is to be understood that the key 5 varies the tension of the line and produces a signal at the relay R, regardless of the position of the magnet A or its equivalent in the line, and that the polarity of the line is not changed by operating the key *k;* but by said key *k* a momentary change in the condition of the line is produced that is responded to in the telephone.

A condenser or secondary battery in the line acts the same as the electro-magnet A, when the flow of the current through the same is reversed by the circuit-connections without the circuit being broken.

I remark that numerous telephones may be placed in the line at various stations, and that all will respond whenever any one of the magnets in the line is reversed in its position in the line, and that these magnets A may be the ordinary relay-magnets of the Morse or other system.

By adding the key and connections one station can signal another or converse with another over the main-line wire without breaking the circuit.

I do not herein claim the combination in one circuit of telephone-instruments and the Morse instruments, as the same is set forth in my prior application No. 132.

I claim as my invention—

1. The method herein specified of producing an electric condition in the closed circuit of a telegraph-line that will give a signal in a telephone by reversing the position in that line of an electro-magnet, secondary battery, or similar device, substantially as specified.

2. The combination, in a closed circuit, of a receiving-magnet, a telephone, an electro-magnet, or its equivalent, and an apparatus for reversing the connections of the same in the circuit, a rheostat or resistance, a shunt to the same, and a key, substantially as set forth.

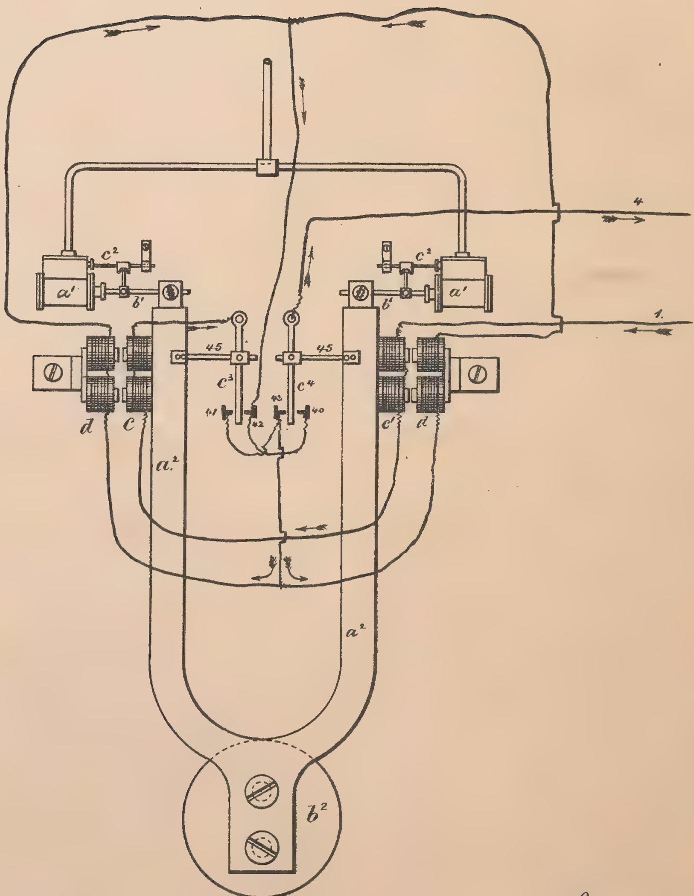
Signed by me this 11th day of November, A. D. 1878.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
MARTIN N. FORCE.

T. A. EDISON.
Magneto Electric Machine.

No. 218,166. Patented Aug. 5, 1879.



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas Alva Edison.

per Lemuel W. Serrell

att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN MAGNETO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **218,166**, dated August 5, 1879; application filed December 9, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in the Method of and Means for Developing Electric Currents, of which the following is a specification.

It has long been known that if two electro-magnets or an electro-magnet and a permanent magnet be drawn apart or caused to pass by each other electric currents will be set up in the helix of the electro-magnet. It has also been known that vibrating bodies—such as a tuning-fork or a reed—can be kept in vibration by the exercise of but little power. I avail of these two known forces and combine them in such a manner as to obtain a powerful electric current by the expenditure of a small mechanical force.

In the drawing, a tuning-fork, a^2, is represented as firmly attached to a stand, b^2. This fork is preferably of two prongs; but only one might be employed upon the principle of a musical reed. This vibrating bar or fork may be two meters long, more or less, and heavy in proportion. It has its regular rate of vibration, like a tuning-fork, and the mechanism that keeps it in vibration is to move in harmony. A crank and revolving shaft or other suitable mechanism may be employed; but I prefer a small air, gas, or water engine applied to each end of the fork.

The cylinder a' contains a piston and a rod, b', that is connected to the end of the bar, and steam, gas, water, or other fluid under pressure acts within the cylinder, being admitted first to one side of the piston and then the other by a suitable valve. The valve and direct-acting rod c^2 are shown for this purpose.

The bar or fork a^2 may be a permanent magnet or an electro-magnet, or else it is provided with permanent or electric magnets. I have shown electro-magnets c c' upon the prong of the fork. There may be two or more on each, and opposed to these are the cores of the electro-magnets d. Hence as the fork is vibrated a current is set up in the helix of each electro-magnet d in one direction as the cores approach each other and in the other direction as they recede. This alternate current is available for electric lights; but if it is desired to convert the current into one of continuity in the same direction, a commutator is employed, operated by the vibrations of the fork, to change the circuit-connections each vibration, and thereby make the pulsations continuous on the line of one polarity. A portion of the current thus generated may pass through the helices of the electro-magnets c' to intensify the same to the maximum power, and the remainder of the current is employed for any desired electrical operations wherever available. I however use the same especially with my electric lights.

I have represented commutator springs or levers c^3 c^4, operated by rods 45, that slide through the levers c^3 c^4, and by friction move them. When the prongs a^2 a^2 are moving from each other the contact of levers c^3 c^4 will be with the screws 40 41, and the current will be from line 1 through c' to c, thence to c^3, to 41 43, and to circuit of electro-magnets d d, and from d d by 42 to 40, c^4, and line 4, as indicated by the arrows. When the prongs a^2 a^2 are vibrating toward each other the circuit will be through c' c c^3 42, in the reverse direction through the circuit and magnets d d, back to 43, and by c^4 to line 4.

I claim as my invention—

The combination, with a vibrating body similar to a tuning-fork, of mechanism for maintaining the vibration, and magnets, cores, and helices, whereby a secondary current is set up, so as to convert mechanical motion into electric force, or the reverse, substantially as set forth.

Signed by me this 3d day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

T. A. EDISON.
Apparatus for Electric Lights.

No. 218,167. Patented Aug. 5, 1879.

Fig. 1.

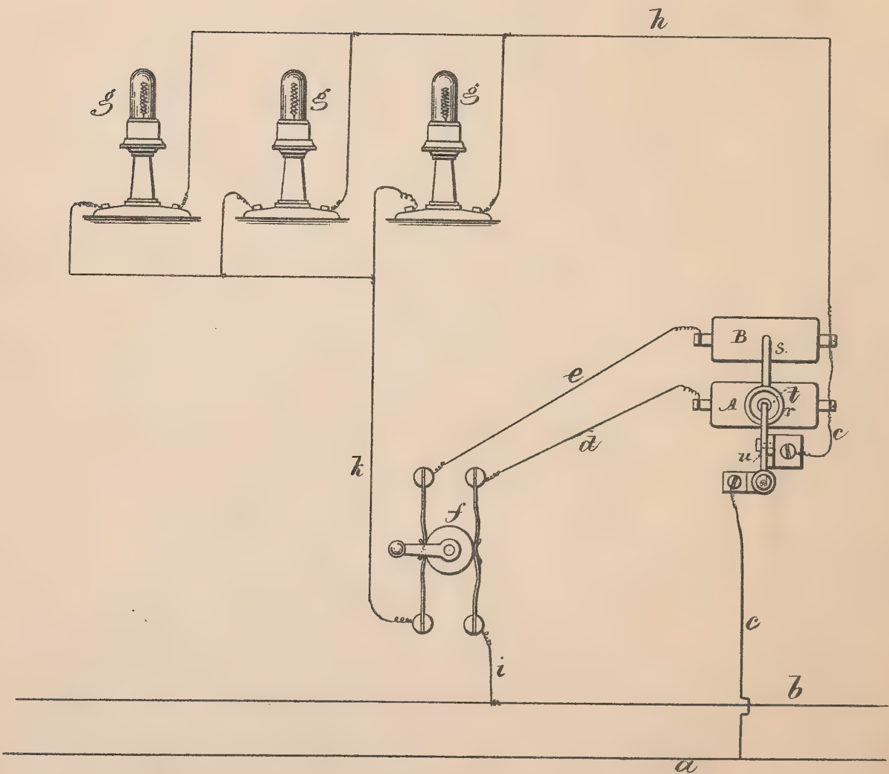


Fig. 3.

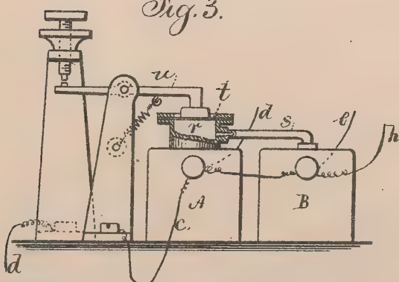
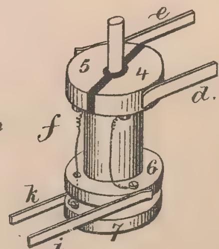


Fig. 2.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison

per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN APPARATUS FOR ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **218,167**, dated August 5, 1879; application filed January 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Apparatus for Electric Lights, of which the following is a specification.

It is well known that an electric current passed through a secondary battery is stored up or reacts after the original current ceases, so that it can be used as a source of electricity.

I employ two secondary batteries, such as those known as the "Plante batteries." One of these is connected in the main circuit, and the same becomes charged. A circuit-changer is introduced in the circuits in such a manner as to connect this charged battery with one or more electric lights, and simultaneously throw the main circuit through the other secondary battery, to charge the same, after which that is connected with the electric lights, and the main circuit reconnected to the first secondary battery, and so on.

In the annexed diagram, Figure 1, the circuit-connections are illustrated, and Fig. 2 is a perspective view of the switch. Fig. 3 is a side view of the secondary batteries.

The secondary batteries A B are of any desired construction. I prefer, and use, two sheets of lead wound together into a square or cylindrical form, and immersed in acidulated water in a closed case.

The main line *a* is connected with any magneto-electric machine or other source of electric energy, and *b* is the return-line or earth-connection.

The main line *a* is connected by the wire *c* to the secondary batteries A B, and the return-wires *d e* pass through the switch *f* and wire *i* to *b*.

The electric lamps *g* are represented in branch circuits between the wires *h* and *k*. The wire *h* connects to one of the secondary batteries A B, and the wire *k* connects to the switch *f*.

The switch *f* is preferably cylindrical, with two insulated half-cylinders, 4 and 5, against which the springs of *c d* rest; and from these half-cylinders are metallic connections to the insulated disks 6 and 7, respectively, against the peripheries of which the springs of *i k* rest, and this switch can be rotated periodically by a handle or by a clock-work or other suitable means.

When the switch *f* is in one position the main circuit is closed through *a*, *c*, A, *d*, 4, 6, and *i* to *b*, and the secondary circuit is closed from B through *h*, lamps *g*, wire *k*, switch 7 5, and wire *e* to B.

When the switch *f* is in the other position the main circuit from *a* passes by *c* to B, and by *e*, 4, 6, and *i* to *b*, while the secondary circuit from A is by *h* through lamps *g*, wire *k* 7 5, and wire *d* to A, so that when the secondary battery B is furnished the accumulated electricity to the lamps *g* the main current is changed to secondary battery A, and vice versa.

The switch *f* may be actuated periodically by clock-work or any suitable mechanism.

When a secondary battery is fully charged, the decomposition of the liquid commences and gases are developed. I avail of this to actuate a circuit-regulator and disconnect the main current.

The two closed cases in which the secondary batteries are placed are provided with tubes *s*, passing to a chamber, *r*, beneath a flexible diaphragm, *t;* and in the metallic circuit *c* there is a switch or lever, *u*, that is acted upon to break the electric circuit to the secondary batteries when the gases have accumulated sufficient pressure to move said diaphragm.

The accumulated gases combine, and in so doing maintain the electric action of the secondary batteries, and the pressure decreases, and the circuit is again closed by the lever *u*.

I am aware that gas has been produced by an electric current decomposing a liquid, and that the confined gas has been employed to move electrodes and regulate the main current.

I claim as my invention—

1. The combination, with electric lamps and a main circuit, of two secondary batteries and circuit-connections and switch, substantially as set forth, to alternately change the main and secondary circuits, substantially as specified.

2. The secondary circuit, containing electric lamps, and the secondary battery and inclosing-case, in combination with the main circuit through the secondary battery, a diaphragm acted upon by the accumulation of gas in the secondary battery, and a switch-lever in the main circuit, substantially as and for the purpose specified.

Signed by me th s 31st day of December, A. D. 1878.

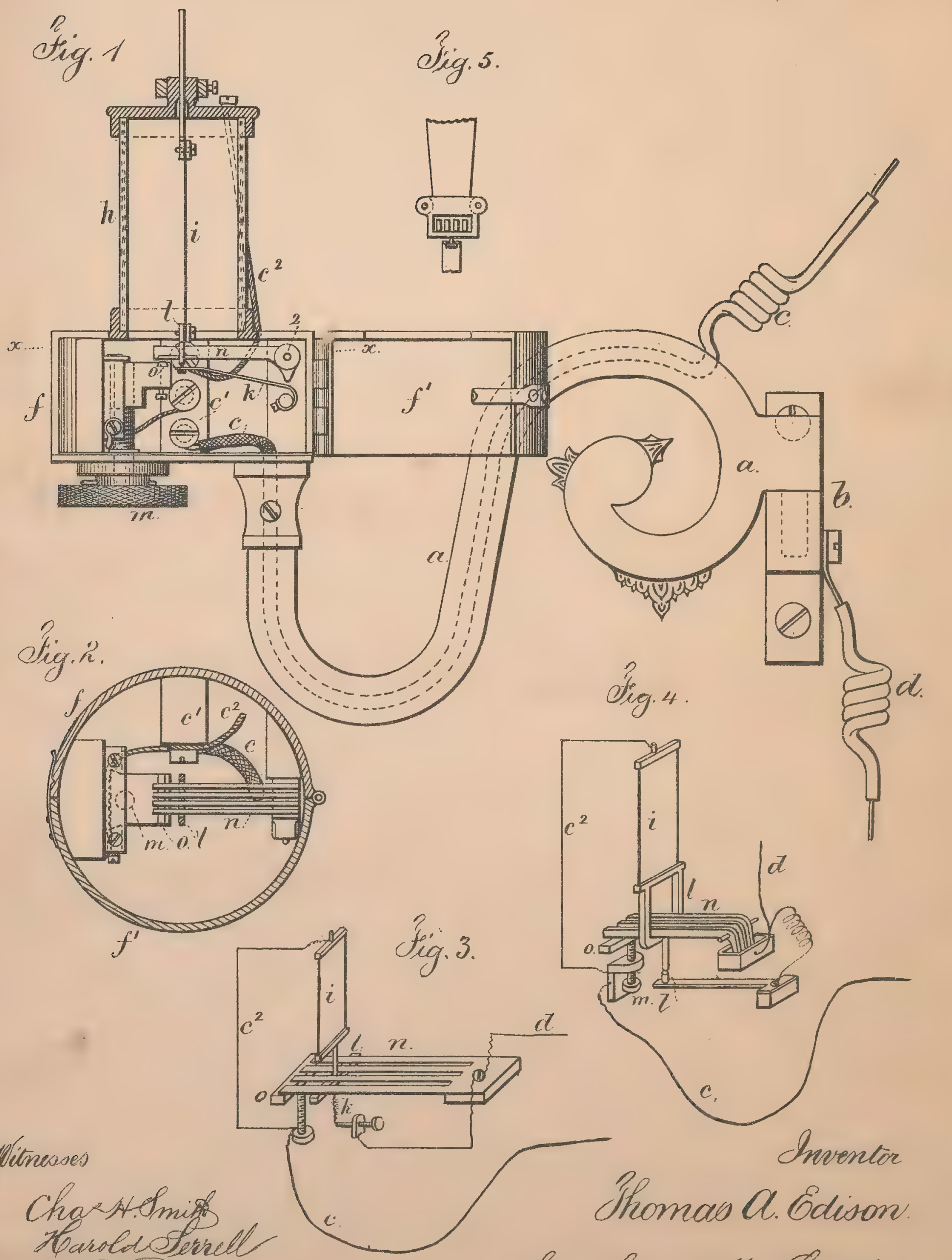
THOMAS A. EDISON.

Witnesses:
WM. CARMAN,
BENJ. D. ACKER.

T. A. EDISON.

Electric Lighting Apparatus.

No. 218,866. Patented Aug. 26, 1879.



Witnesses

Chas H. Smith

Harold Serrell

Inventor

Thomas A. Edison

per Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTING APPARATUS.

Appl filed Dec 3 - 1878

Specification forming part of Letters Patent No. **218,866**, dated August 26, 1879.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in State of New Jersey, have invented an Improvement in Electric Lighting Apparatus, of which the following is a specification.

In an application before filed by me, the light-giving body is combined with the circuit-connections and a thermal regulator that prevents injury to the apparatus by short-circuiting the current or placing a resistance therein. I do not therefore herein claim any such device.

My present invention relates to the combination, with the light-giving body, of a range of levers and contact-surfaces arranged in such a manner that the current is short-circuited or shunted to a greater or less extent, according to the heat of the incandescent light-giving body.

In the drawings, Figure 1 is an elevation of the bracket and a section of the light-giving apparatus. Fig. 2 is a sectional plan at the line *x x*. Figs. 3 and 4 are diagrams of the circuit-connections; and Fig. 5 is a partial elevation endwise of the shunting-levers.

The bracket *a* is sustained by a socket and pin at *b*, so that it may be swung like a gas-fixture.

c is one of the electric conductors. The same is insulated and passes into an opening in the bracket, and thence to the electric light, and the return-circuit is through the pipe *a* to the wire *d*, or to the gas pipe, if the bracket is upon a gas-pipe.

The conductor *c* passes to the insulated plate c^1 within the case *f*, and, for convenience, this case *f* has a swinging door, f', in one side to give access to the interior parts. Above the case *f* is a glass cylinder, *h*, or other suitable protection for the electric light, and *i* is a strip of platina-foil or other known or desired light-giving material that can be rendered incandescent and produce the necessary light without melting. The conductor c^2 passes to one end of this light, and the other end of *i* is connected by the spring *k* with the metal part of the bracket, and thence to *d*.

The spring *k* serves to keep a slight tension on the foil *i*, and the yoke or frame *l* intervenes between the spring *k* and the foil.

There are levers *n*, or springs, that are connected at 2, and their free ends rest in and upon the yoke or frame *l*, and their ends should be tipped with platina.

The bar *o* is preferably of platina, and it is adjustable by means of the screw *m*, that raises or lowers the same, so as to bring it nearer to or farther from the ends of the levers or springs *n*. This adjustment is made so that the ends of the springs or levers *n* will not be in contact with the bar *o* while the light is in its normal condition; but when the heat of the foil *i* becomes excessive the expansion allows the ends of the springs or levers *n* to come into contact with the bar *o* and set up a shunt or short circuit from *c o*, through *n*, to *d*, and, according to the amount of expansion in *i*, so one, two, or more of the bars or springs *n* will be in contact with *o*, because said bar *o* is farther from the levers *n* at one end than at the other. By this means injury to the light-giving body is prevented, and a path established for the electric current becomes less in resistance as the points of contact between *n* and *o* increase in number.

The lower end of the yoke *l* may come into contact with the spring or stud *t* at the extreme expansive movement, as seen in Fig. 4, to still further lessen the resistance between *c* and *d* and divert the current from the foil *i*.

The ends of the levers *n* may be in a bath of mercury, as seen in Fig. 4, to insure electric contact. If the foil *i* is accidentally broken or injured the circuit through *n* is instantly closed, so that other lights in the same circuit are not extinguished. This device is automatic, so as to avoid the extinguishment of other lights.

I claim as my invention—

1. The combination, with the light-giving body, of two or more circuit levers or springs, *n*, a yoke, *l*, a contact-bar, *o*, and the circuit-connections, substantially as set forth, for lessening the resistance of the shunt as the temperature of the light-giving body increases, as specified.

2. The circuit connection *t*, in combination with the levers or springs *n*, yoke *l*, light-giving body *i*, and circuit-connections, substantially as set forth.

Signed by me this 3d day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:
STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

2 Sheets—Sheet 1.

T. A. EDISON.

Dynamo-Electric Machine.

No. 219,393. Patented Sept. 9, 1879.

Fig. 3.

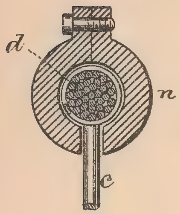
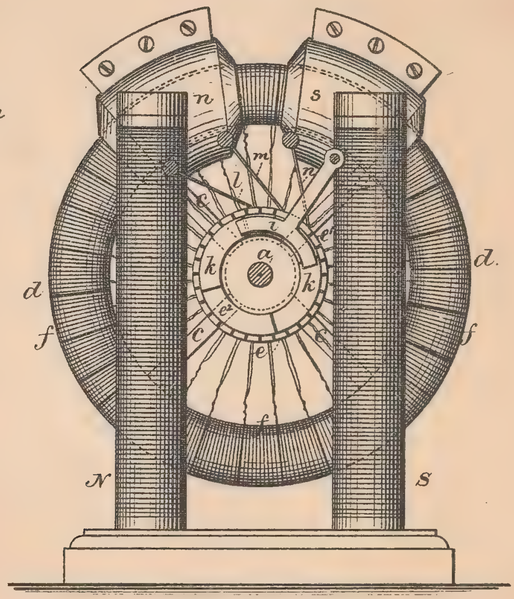
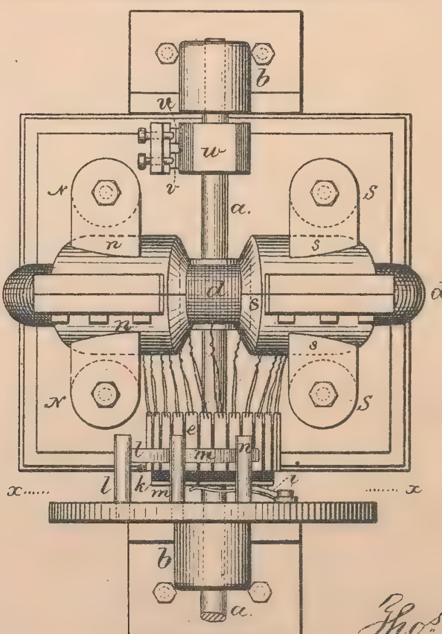


Fig. 2.



Case No. 180.

Fig. 1.



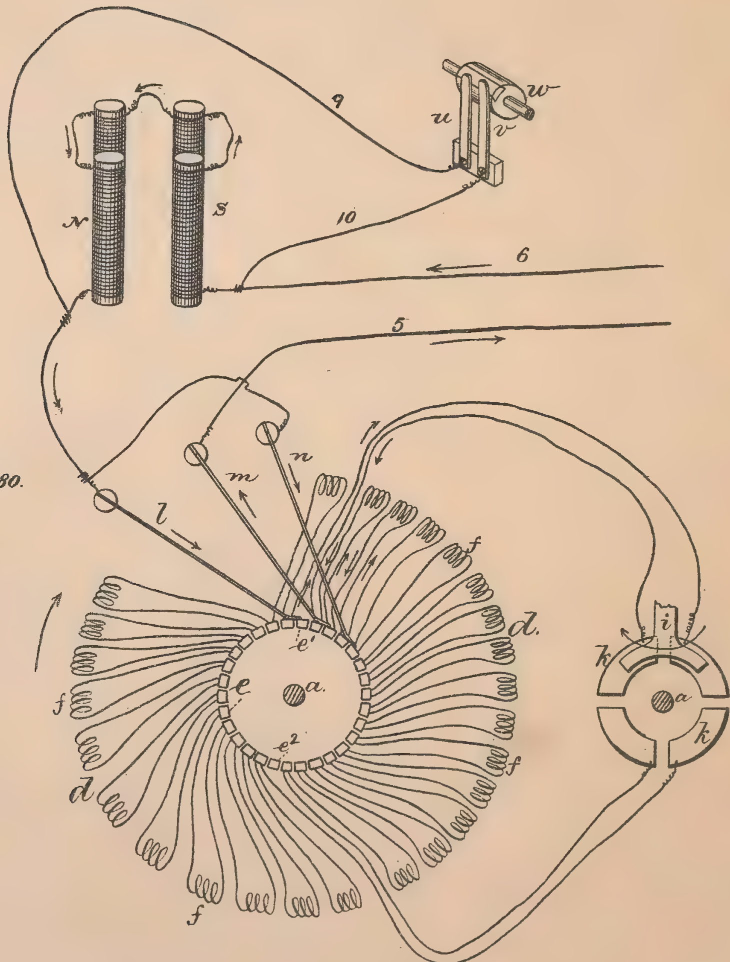
Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thos. A. Edison
per Lemuel W. Serrell
atty

T. A. EDISON.
Dynamo-Electric Machine.

No. 219,393. Patented Sept. 9, 1879.

Fig. 4.



Case no. 180.

Witnesses

Chas H. Smith
Harold Serrell

Inventor

Thos A. Edison

per Lemuel W. Serrell

att'y.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN DYNAMO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **219,393**, dated September 9, 1879; application filed July 10, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Dynamo-Electric Machines, (Case 180,) of which the following is a specification.

I make use of a ring supported by arms and revolved between the cores of a field-of-force magnet. There are helices around this ring connected to commutator-plates, and the current is taken off by three springs, two of which are connected together and receive the current of one polarity, and the other spring receives the current of the opposite polarity. The helices of the ring as they are revolved through the magnetic field of the field-of-force magnets have the secondary current set up in them, and the same is taken off by the commutators aforesaid. To insure the entire current passing off by the commutators, and to prevent the secondary current circulating in the helices of the revolving ring, the continuity of the helices or helical sections is interrupted at two or more places, and to avoid the interruption of the line-current I use a stationary bridge and revolving contact-blocks to close the circuit at the interruption of the helix-wire when the same is in the line-circuit through the commutators.

I have discovered that an increased magnetic effect is produced in the field-of-force magnets by periodically shunting the current, as will be more fully described hereinafter.

In the drawings, Figure 1 is a plan of the machine. Fig. 2 is an elevation with the frame removed at the line x x. Fig. 3 is a section through the ring and the core-extension of the field-of-force magnet, and Fig. 4 is a diagram of the connections.

The shaft a is supported in suitable bearings, b, and revolved by power. Upon this shaft are arms c, that sustain the ring d. This ring may be of one piece of iron, but I prefer to use fine wire wound into a coil or ring, and having a circular form sectionally, as seen in Fig. 3.

Around the ring d there are helices wound in numerous sections, f, and the wires are taken off to commutator-plates e, as illustrated in the diagram Fig. 4. One end of one helix-wire is joined to the same commutator-plate e as one end of the next helix-wire, except at two or more places around the ring, where there is a break in the metallic connections of the helices. I have shown two such breaks at the blank commutator-bars e' e^2, where the wires, instead of passing from the helical sections to such plates e' e^2, pass to the secondary commutator-blocks k, composed of four insulated blocks; and i is a stationary bridge of metal against which the blocks k revolve. These blocks k are upon a cylinder of insulated material on the shaft a and revolve with it. The operation will be hereinafter explained.

The field-of-force magnets N S are wound with helices, and there are lateral-projecting cores n s, with openings through them in which the ring d is revolved, said lateral cores being close to the helices of the rings, but not touching the same, as seen in Fig. 3, so that the helices pass across the magnetic field somewhat the same as in the Páccincti or Gramme machines.

The commutator-springs l m n bear upon the commutator-plates, and the circulation of the electric current will be from the springs l and n through the helices that are in the field of magnetic influence, and thence by the spring m, or the reverse, according to the polarity of the field-magnets and the direction of revolution, the same polarity of secondary current being set up in the helix-section that is approaching it that is set in another helix that is moving away from s. Hence the springs l and n are connected to one line-wire, and the opposite polarity of current is set up through m, as indicated by the arrows, Fig. 4, said spring m connecting to the neutral point between the poles of the field-magnets.

From the foregoing it will be understood that a continuous current is set up in l m n from those helix-sections that are passing through the magnetic field. The commutator-springs, however, have to bear upon two of the commutator-plates at the same time to avoid interruption in the current or a spark. The current passes from m out upon the line-wire 5 and returns upon the line-wire 6 to l n, or the reverse, and the helices of the field-of-force magnets N S are in this circuit, as shown in Fig. 4.

The secondary commutator-blocks k, being

insulated, form two breaks in the helix-sections; but the stationary bridge i is in such a position that the circuit is maintained in the helices that are in the magnetic field, such bridge answering the same purpose as it would to connect the helix-wires continuously to the commutator-plates $e' e^2$. The metallic circuit, however, is broken on the opposite side at the commutator e^2, so that currents cannot circulate through the ring of helices. As the connections are illustrated, it will be seen that the current is always free to circulate through the helices of the field-of-force magnets, and under ordinary circumstances the electric effect will be augmented until the maximum effect is attained. I have discovered that by combining with the field-of-force magnet and the circuit through the same a shunt, open and closed periodically, the dynamic effect is greatly increased.

9 and 10 are shunt-wires from the line-circuit at each side of the helices of the field-magnets, and u v are springs bearing upon a cylinder, w, that is upon the shaft a and is revolved with it. Part of the surface of w is of conducting and part of insulating material. When the springs u v rest upon the conductor the current is shunted or short-circuited, and, finding a route of less resistance, does not pass through the helices of the field-of force magnets, and acquires thereby increased volume, as the resistance is less; but so soon as the non-conducting material comes into contact with u and v the shunt is broken, and the increased current, having no other route, is obliged to pass through the helices of the field-magnets and augments the magnetism and increases the current, so that the energy of the machine is promoted by shunting the field-of-force magnets; and this I do every revolution of the shaft a, but it may be done more or less frequently.

By the arrangement shown the helices of the ring are not liable to become heated, because the current passes through, but a small portion of the ring, and the other parts of the ring are open to atmospheric influence and free to cool.

I claim as my invention—

1. In a magneto-electric machine, a ring of helical sections connected to commutator-plates, and the metallic circuit interrupted at two or more places, in combination with the field-of-force magnet, the springs l n, connected together and to one wire of the circuit, and the intermediate spring, m, to the other wire of the circuit, substantially as set forth.

2. The combination, in a magneto-electric machine, of a field-of-force magnet, revolving helix-sections, commutator-plates to which the helix-sections are connected, the springs l m n, the secondary commutator blocks k, and a metallic bridge, i, to the same for maintaining metallic connection in the helices that are within the field magnets, substantially as set forth.

3. In a dynamo-electric machine, a shunt around the helices of the field-of-force magnets, and means for opening and closing that shunt periodically, for the purposes and substantially as set forth.

Signed by me this 7th day of July, A. D. 1879.

THOS. A. EDISON.

Witnesses:
S. L. GRIFFIN,
FRANCIS R. UPTON.

T. A. EDISON.
Electric-Light.

No. 219,628. Patented Sept. 16, 1879.

Fig. 1.

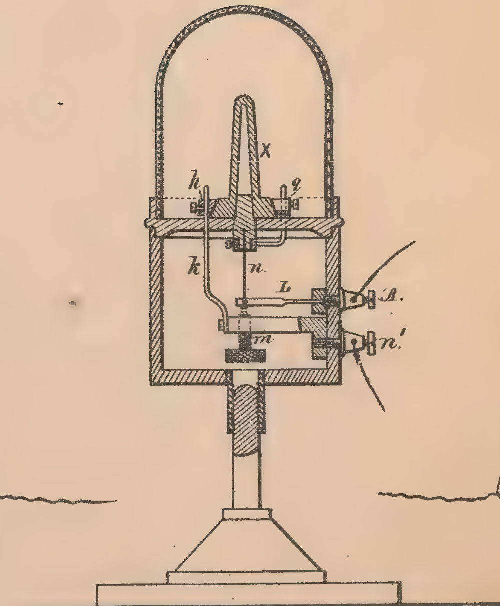


Fig. 2.

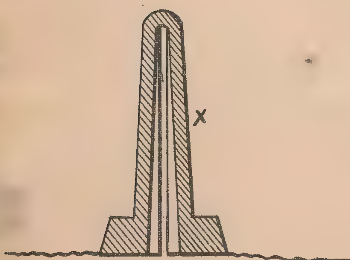


Fig. 3.

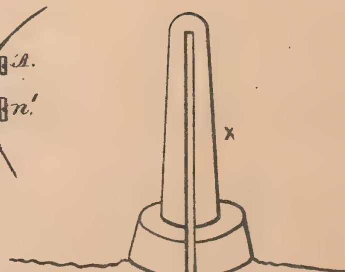
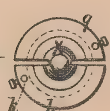


Fig. 4



Witnesses

Chas H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison.

per Lemuel W. Serrell

att'y

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **219,628**, dated September 16, 1879; application filed December 9, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Electric Lights, and the following is declared to be a description of the same.

The object of this invention is to produce a candle or light-giving body by the incandescence of a conductor of electricity in the form of a cylinder, prism, or other mass of a size adapted to yield the required volume of light.

The invention consists in an electric-light-giving body formed of a conductor, such as finely-divided platinum, iridium, ruthinium, or other metal difficult of fusion, incorporated with non-conducting material.

The candle, made as aforesaid, can be of any desired size or shape, and the metallic particles become incandescent by the passage of the current, and the non-metallic materials are luminous and increase the brilliancy. This is accomplished by a comparatively small electric current. I mix with such finely-divided conductors infusible materials—such as oxide of magnesium or zirconium—in different proportions, so as to obtain any degrees of conductivity required.

In some instances I saturate rods, sheets, or other forms of infusible oxides with a salt of the metal difficult of fusion, and reduce the same by heat to a metallic state.

I will mention that the use of a non-conducting material is not absolutely necessary, as the finely-divided metals, owing to their porosity, have high resistance, and become easily incandescent; but I prefer to use the non-conductor.

In Figure 1 is shown a lamp composed of finely-divided iridium mixed with oxide of zerconium and molded in the form of a split hollow cylinder, *x*. Fig. 2 is a detached section of the same. Fig. 3 is a perspective view, and Fig. 4 is a plan view.

The cylinder being split, the current enters the binding-post A, passes through the lever L, through the regulating-wire *n* to the plate *g*, thence up one side of the iridium cylinder *x*, down the other side to the plate *h*, thence, by wire *k*, to the regulating-screw *m* and binding-post *n'*.

The regulation of the temperature of the cylinder *x* is obtained by the thermal-current regulator in the same manner as is shown in my application No. 156, filed October 14, 1878.

The incandescent conductor made in this manner may be of any desired shape.

I claim as my invention—

1. For electric lighting, a conductor of electricity formed of finely-divided metal incorporated with a non-conductor of electricity, substantially as set forth.

2. A rigid electric-light-giving body having a longitudinal incision or separation from the base to near the end, for insuring the circulation of the electric current through the entire body, substantially as set forth.

3. In combination with a rigid light-giving body having a longitudinal incision, an expansive thermal-circuit regulator to control the strength of the current by the heat developed, substantially as set forth.

Signed by me this 3d day of December, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

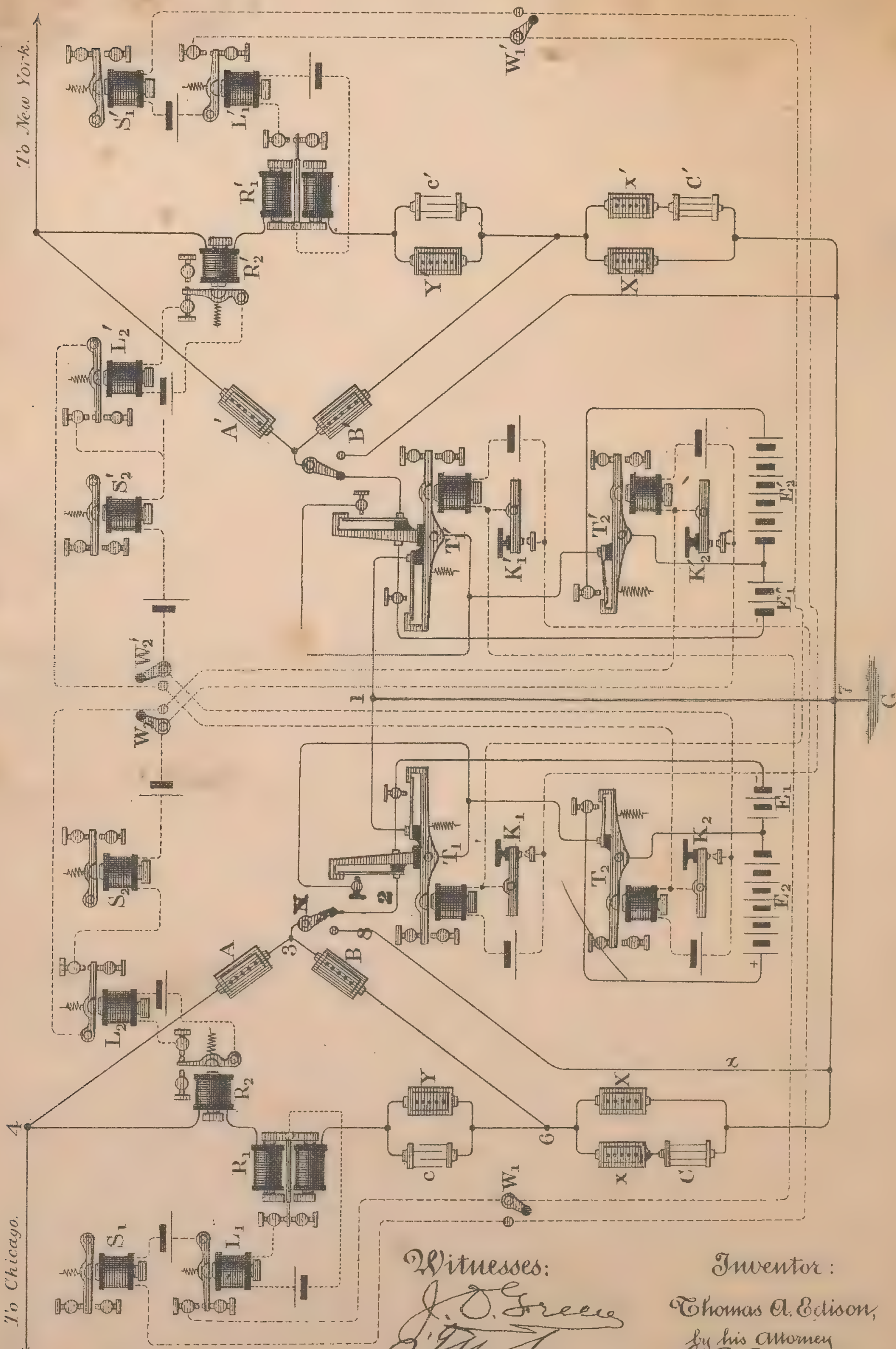
STOCKTON L. GRIFFIN,
GEO. E. CARMAN.

T. A. EDISON,

Assignor of one-half interest to G. B. PRESCOTT.

Quadruplex-Telegraph Repeater.

No. 8,906. Reissued Sept. 23, 1879.



Witnesses:

J. O. Greene

[illegible]

Inventor:

Thomas A. Edison,

by his Attorney

G. P. Lowrey

N. PETERS. Photo-Lithographer. Washington, D. C.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR OF ONE-HALF INTEREST TO GEORGE B. PRESCOTT.

IMPROVEMENT IN QUADRUPLEX-TELEGRAPH REPEATERS.

Specification forming part of Letters Patent No. 209,241, dated October 22, 1878; Reissue No. **8,906**, dated September 23, 1879; application filed November 16, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, now of Menlo Park, in the county of Middlesex and State of New Jersey, have invented certain new and useful Improvements in Quadruplex Telegraphs, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

My present invention consists in certain improvements upon the apparatus described in my application for Letters Patent filed on or about the 1st day of September, A. D. 1874, for improvement in duplex telegraphs, and designated as Case 99; and has for its object, first, to provide means of compensating the effects of static induction and discharge upon the instruments at the receiving-station when two sets of signals are transmitted simultaneously in the same direction without interfering with the transmission of one or more sets of signals in the opposite direction; second, to provide means whereby the adjustment of the balance at either station, in a system of duplex or quadruplex telegraphy, may be conveniently effected without interference from the transmitting-instruments or batteries at the other station; and, third, to provide means whereby two quadruplex circuits may be coupled together, so that two sets of signals may be repeated from the first circuit into the second at the same time that two other sets of signals are being repeated from the second circuit into the first.

In the accompanying drawings I have shown two complete sets of apparatus arranged for quadruplex transmission, in order to properly illustrate the method of repeating from one set of apparatus to the other. As these two sets of apparatus are exact counterparts of each other, the same letters of reference have been applied to each, those pertaining to the right-hand set being distinguished by a prime mark.

In my hereinbefore-mentioned application designated as Case 99, I have described a duplex telegraph in which two independent sets of signals may be simultaneously transmitted over a telegraphic circuit in the same direction, one instrument at the receiving-station responding solely to changes in the polarity of the current, and the other instrument solely to changes in the strength of the current.

In my present invention the apparatus and method described in Case 99 are combined with the arrangement of circuits and method of simultaneous duplex transmission in opposite directions set forth in Letters Patent of the United States granted to Joseph B. Stearns on the 12th day of November, A. D. 1872, No. 132,932, and reissued on the 22d day of June, 1875, No. 6,508, by means of which combination I am enabled to simultaneously transmit four independent sets of signals over one wire.

When this combined apparatus, technically termed a "quadruplex telegraph," is applied to a submarine cable or a land-line of considerable length, the correct operation of the system is materially interfered with by the phenomena of static induction and discharge which manifest themselves upon the receiving-instruments. The tendency of the return discharge from the outgoing currents is to produce a false signal upon the receiving-instruments at the home station each time that the current is reversed, or the key-connection is changed from the battery to the earth. This effect is neutralized by the application of a rheostat and condenser to the artificial line in the manner fully set forth in Letters Patent of the United States No. 126,847, granted to Joseph B. Stearns on the 14th day of May, A. D. 1872, and reissued as No. 5,344 on the 1st day of April, 1873, to which reference is had.

The effect upon the receiving-instruments, when two sets of signals are being simultaneously received, of the static induction which arises from the incoming currents is entirely different and distinct from that caused by outgoing currents, and requires a different method of compensation. The manner in which I have effected this compensation will be hereinafter set forth.

Referring to the drawings, T_1 is a current-reversing or pole-changing transmitter, which is operated, in the usual manner, by a finger-key, K_1, and local battery. It is connected

with the ground G at the point 1, and with the line at the point 2, and is so arranged that when in a position of rest the positive or zinc pole of the battery E_1 is to line and the negative or copper pole to the earth; but when depressed the polarity of the battery with respect to the line and earth is reversed. T_2 is a single-current transmitter, which, when depressed, simply connects the battery E_2 to the battery E_1; and as the former is, say, three times the size or strength of the latter, the effect of depressing the transmitter T_2 is simply to increase the strength of the current going to line irrespective of its polarity.

One receiving-instrument, R_1, responds solely to changes in the polarity of the current traversing its coils without reference to its strength, while the other instrument, R_2, responds solely to changes in the strength of the current without reference to its polarity. The two sounders S_1 and S_2 are, respectively, operated by the receiving-instruments R_1 and R_2 through the intervention of the local relays L_1 and L_2.

The apparatus thus for described is essentially the same in construction and mode of operation as that described in my hereinbefore-mentioned application, No. 99; but in order to convert this into a quadruplex apparatus, it is necessary to combine it with some system of duplex transmission in opposite directions.

I have shown in the drawings the hereinbefore-mentioned method patented by Joseph B. Stearns, in which the outgoing current from the transmitter T_1 divides at the point 3 between the main line 3 4 5 and the artificial line 3 6 7. The receiving-instruments R_1 and R_2 are placed in a bridge-wire, 4 6, which is rendered neutral to outgoing currents in accordance with a well-known law by so adjusting the artificial resistances or rheostats A, B, and X that the proportion of A to B is the same as that of the line to X. The electrostatic capacity of the line is balanced by the condenser C, which is attached to the artificial line, and is therefore charged and discharged simultaneously with the main line, the duration of the discharge being regulated by means of the adjustable rheostat x. This condenser is not effected by the incoming currents, as the resistence between the point 6 and the earth at 7 is so much greater by the way of the rheostat X than by the way of 3, 2, and 1 that the position of the received current passing by that route is inconsiderable.

The effect of electro-static induction upon the alternate positive and negative signals sent by the transmitter T_1 and received by the instrument R_1 is to shorten them by increasing the length of the neutral space which separates them, and this effect increases in proportion to the square of the length of the line. The result is that on a long line there is a tendency in the receiving-instrument R_1 to shorten dashes into dots and to obliterate dots altogether. Moreover, if a reversal occurs while a signal is being made upon the receiving-instrument R_2 the armature of the latter often falls off for so great a length of time as to make a break in the signal.

I have succeeded in compensating this effect by placing a condenser, c, between the main and artificial lines, so that one set of its plates is in connection with a point in the main line, and the opposite set of plates in connection with a point in the artificial line, having the same potential with respect to outgoing currents. When the receiving-instruments are placed in a bridge-wire, as shown in the drawings, the condenser may also be attached to the bridge-wire. It is obvious that in this position it can only be charged and discharged by the action of incoming currents. When, for example, a positive current is traversing the receiving-instruments, the condenser c receives a positive charge, and at the movement of reversal gives it out again in advance of the arrival of the negative current from the distant station. This positive discharge passes through the receiving-instruments R_1 and R_2 in the reverse direction, and produces the same effect upon them as a negative current, instantaneously succeeding the termination of the positive current, thus compensating the effect of static induction upon the received signals.

The amount of charge in the condenser c is regulated, as required, by means of the rheostat Y, which is inserted in the bridge-wire between the points of connection of the condenser, the charge being always in proportion to the resistance unplugged.

In the system of quadruplex transmission which has been described there is always a current upon the line, either positive or negative, from the battery E_1, and this current, when arriving from the distant station, renders it impossible for the operator at the home station to adjust the resistances, or, as it is technically termed, "balance" the instruments. To avoid this difficulty I provide a three-point switch, N, which is placed between the point 3 at the junction of the main and artificial lines and the transmitter T_1, so that by turning the switch to connect the point 3 with the wire 8, instead of the wire 2, the line may be connected directly to the earth at G without including the battery E_1. This arrangement enables the balancing to be effected without difficulty.

In order to arrange two sets of quadruplex apparatus upon two different lines, so that each set of signals may be repeated over the other line, it is necessary to connect the receiving-instruments of each line to the corresponding transmitters of the other line, which is most conveniently done by means of the local circuits. Thus in the drawings the two sets of quadruplex apparatus are supposed to be placed at Buffalo, the left-hand line going to Chicago and the right-hand line to New York. By tracing the connections (shown in dotted lines) it will be observed that the local circuit of receiving-sounder S_1 is continuous with the local circuit of transmitter T'_1, and in like man-

ner the local circuit of sounder S_2 is continuous with the local circuit of transmitter T'_2. In precisely the same manner S'_1 and S'_2 are connected with T_1 and T_2.

By closing the switches W_1 and W_2 the local circuits connecting S_1 and T'_1 and S_2 and T'_2 may be divided, permitting each to work independently. The corresponding switches W'_1 and W'_2 on the opposite side serve a similar purpose. In this manner either one of the four separate sets of signals which are being simultaneously transmitted over one circuit may be automatically repeated into the other circuit or not, at pleasure, by opening or closing the corresponding switch.

I claim as my invention—

1. In a duplex or quadruplex telegraph, a condenser having one of its inductive surfaces connected with the main line and the other with the artificial line at points of equal potential with reference to outgoing currents, so as to receive a charge from incoming but not from outgoing currents, substantially as and for the purpose specified.

2. In a duplex or quadruplex telegraph, the combination of a main line, an artificial line, and a bridge-wire connecting the said lines at points of equal potential with reference to outgoing currents, with a rheostat or artificial resistance placed in said bridge-wire, and a condenser, the opposite inductive surfaces of which are connected with the said bridge-wire upon opposite sides of said rheostat, substantially as and for the purpose specified.

3. In a quadruplex telegraph, the combination at one station of two receiving-instruments, one operated by changes in the polarity of the current irrespective of its strength, and the other operated by changes in the strength of the current irrespective of its polarity, with two condensers, one of which receives a charge from outgoing but not from incoming currents, while the other receives a charge from incoming but not from outgoing currents, substantially as and for the purpose specified.

4. In a duplex or quadruplex telegraph, a switch or commutator placed between the transmitting apparatus and the point of junction of the main and artificial lines at the same station, and so arranged that the latter point may be disconnected from the transmitting apparatus and connected directly to the earth, substantially as and for the purpose specified.

5. In combination with two main-line circuits, each capable of quadruplex operation, the repeating-magnets, local circuits, switches, and connections, arranged substantially as set forth, so that any one set of signals may be repeated independently of any other set, substantially as set forth.

6. The combination, with the receiving-sounders in one line, of repeating-instruments, local circuits and switches, and transmitting-instruments in the other line, arranged and operating substantially as and for the purposes set forth.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,

MARTIN N. FORCE.

2 Sheets—Sheet 1.

T. A. EDISON.
Telephone.

No. 221,957. Patented Nov. 25, 1879.

Fig. 1.

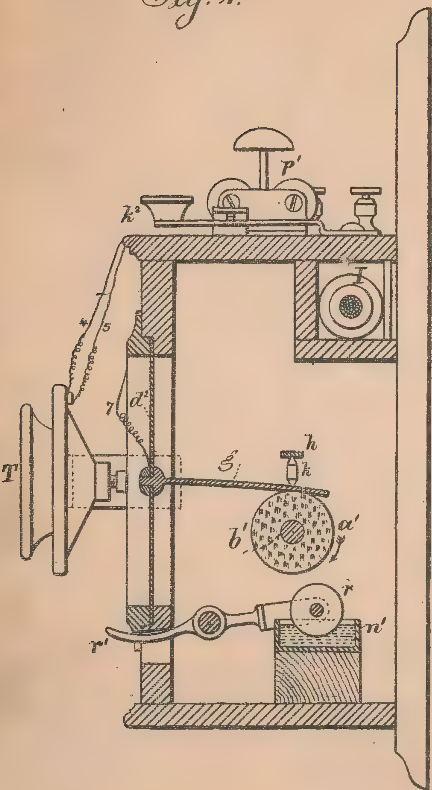


Fig. 2.

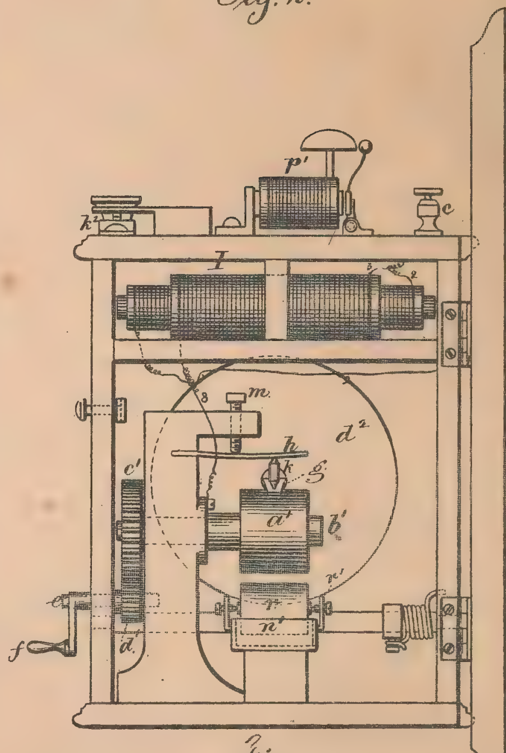
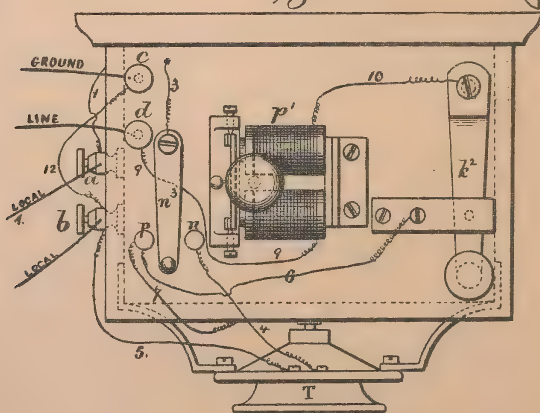


Fig. 3.



Witnesses

Chas H. Smith
Harold Serrell

Inventor

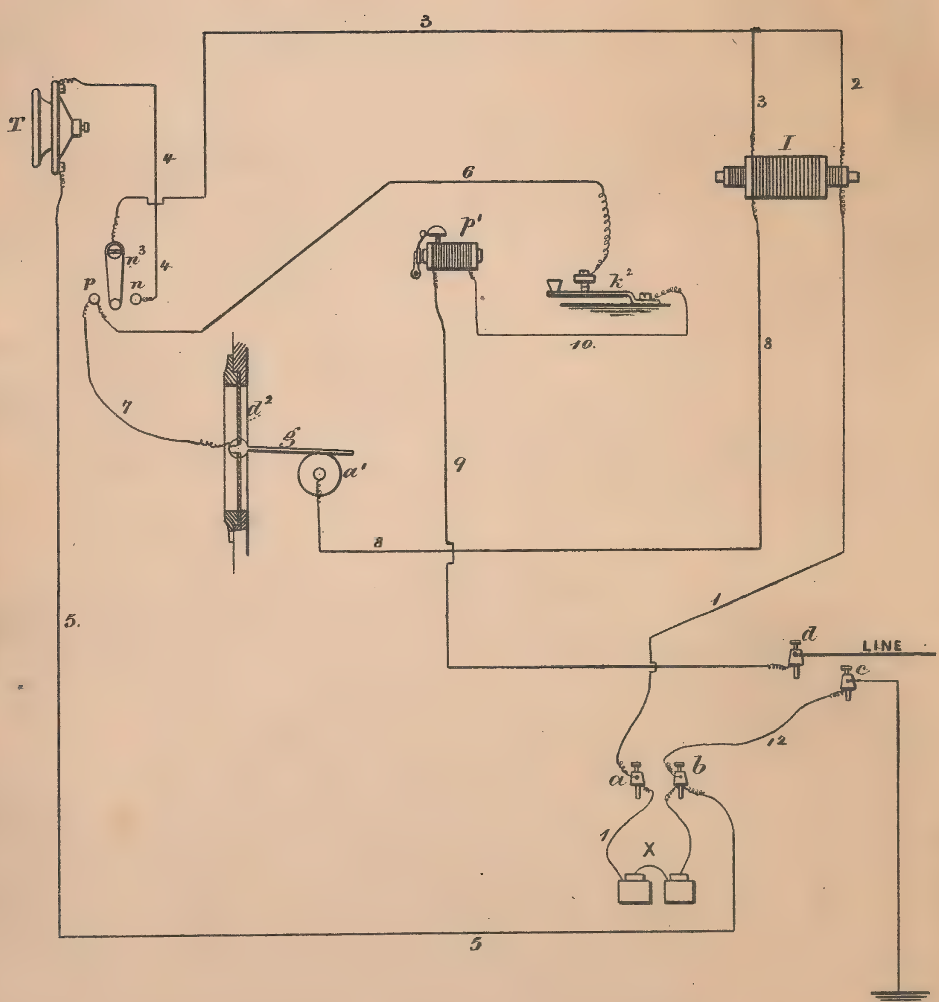
Thomas A. Edison
per Lemuel W. Serrell atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

T. A. EDISON.
Telephone.

No. 221,957. Patented Nov. 25, 1879.

Fig. 4



Witnesses
Chas. H. Smith
Harold Serrell

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN TELEPHONES.

Specification forming part of Letters Patent No. **221,957**, dated November 25, 1879; application filed March 31, 1879.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Telephones, (Case No. 175,) of which the following is a specification.

The object of this invention is to transmit sounds electrically to a distance and reproduce the same with great power and without loss of volume.

The peculiar action upon which this invention is based was patented by me January 19, 1875, and numbered 158,787. An application of this action to telephony was also applied for by me July 20, 1877, No. 141, in which there is a band of paper moving beneath a point connected to the diaphragm. This feature, therefore, is not broadly claimed herein.

The present application consists more particularly in devices which make the invention perfectly practicable for use in commerce, and render the same reliable and effective.

In the drawings, Figure 1 is a section of the apparatus. Fig. 2 is a view of the back of the box. Fig. 3 is a plan view, and Fig. 4 is a diagram representing the connections to the line, local circuit, and various parts of the apparatus.

a' is a cylinder of compressed chalk soaked in an electrolytic solution, such as a caustic alkali, that it may become a conductor of electricity. I will mention that any finely-divided non-conducting material or porous body having capillary pores, and which has no chemical action upon the absorbed solution, may be used. This cylinder is secured to a shaft, b', and the whole is rotated by the operator by means of the toothed wheels c' d', shaft e, and handle f. Worm and pinion may be substituted, and motor-power of a clock-work or analogous motor replace the hand of the operator.

Resting upon the cylinder a' is a flat spring, g, connected to the diaphragm d^2. This spring is pressed upon the chalk with a pressure of several pounds by means of the wire k and spring h, the screw m serving to increase or decrease the amount of pressure.

The line-wire is connected to the spring g, while the earth-wire is connected to the shaft on which the cylinder a' is secured. If, now, the cylinder be rotated in the direction shown by the arrow and no current passes, the normal friction of the spring g upon the surface of the cylinder a' will be very great, and the spring will be carried forward in the direction of the rotation of the cylinder, thus pulling inwardly the diaphragm d^2. If, now, a current passes whose direction is such that hydrogen will be produced upon the surface of the spring g in contact with the chalk, the friction will be reduced to an extent proportionate to the strength of the current; hence the diaphragm will regain its natural position and continue there as long as the current passes. If, now, the current ceases, the normal friction at once is re-established, and the traction increases, and the diaphragm is instantly pulled inwardly again. If, now, a current in the opposite direction is transmitted, the effect is scarcely noticeable, as the evolution of oxygen upon the surface of the spring g does not, except with a few saturations, decrease the friction like hydrogen, but, on the contrary, generally tends to increase the normal friction; hence I allow a constant current to circulate on the line, and am thus enabled to utilize the opposite waves by causing them to weaken the constant current, which is always in a direction to evolve hydrogen on the surface of the spring g.

If no constant current were upon the line, the waves in one direction only would produce a limited effect; but by using a constant current circulating upon the line in addition to the waves of similar and opposite polarity, one polarity of wave is added to that of the current, and the other wave neutralizes, or nearly neutralizes, the constant current; hence the tendency of one wave is to produce a lessening of friction of, say, five units, which, added to that produced by the constant current—say five—together give ten units. If, now, an opposite current is sent, it neutralizes the constant current, and we have the normal friction of the cylinder, whereas if no constant current were used one current would lessen the friction by five units, and the opposite current would perform no work.

n' is a receptacle containing water, and resting in the water is a roller, r, composed of any flexible absorbent substance, such as sponge or felt.

A lever, r', to which the roller is attached, and by which the roller may be brought in contact with the cylinder a', extends through the box to the outside. The object of this device is to supply the cylinder with water lost by evaporation, and make it a conductor to the electric current.

In practice, when all the apparatus is inclosed in a cast-iron case, the loss by evaporation is very small; and if the roller be held against the cylinder and the cylinder be rotated three or four times the chalk will take up sufficient moisture so that it will perform its functions for a week or more without again wetting it.

The connections are as follows: T is a carbon telephone-transmitter, placed in a local circuit with an induction-coil, I, and local battery X. If the position of the switch-lever n^3 is on the button n, then the current proceeds from the local battery X via wire 1, primary coil of I, wire 2 to 3; thence to the switch-lever n^3, wire 4, through the carbon transmitter T; thence by wire 5 to the post b; thence to the battery.

The sonorous waves of the voice are translated into electric waves of a positive and negative character in the secondary coil of the inductorium I in the well-known manner.

The connections of the main line are as follows: The line from the distant station enters at the post d; thence via wire 9 to the call-bell electro-magnet p'; thence via wire 10 to the key-lever k^2; thence by wire 6 to the point p of the switch, and by wire 7 to the spring g of the receiver; thence through the moist chalk to wire 8, to and through the secondary coil; thence via wire 3 to the switch-lever, which, it will be remembered, is in n; thence by wire 4 through the transmitter to wire 5; thence to post b, and by wire 12 to the post c, which is connected to the earth. I will mention that either of the posts d c may be connected to the ground or line.

It will be noticed that the main line passes through the transmitter, which is connected to the local battery; hence a portion of the current leaks into the main line, and it is this portion which thus leaks into the line that serves as a constant current for short lines; but if the line be too long, or has too great a resistance, this small leakage-current is so weakened as to be insufficient to produce a lessening of friction between the spring g and the chalk; hence I insert one or more cells in the main line.

While the switch is in this position—*i. e.*, the lever in contact with r—transmitting and receiving can go on simultaneously. By turning the switch-lever to the point p the telephonic apparatus is disconnected, and the call-bell apparatus p' becomes operative. The line enters at the point d, passes through the call-bell magnet via wire 9, and by 10 to key k^2; thence via 6 to p, and by switch to wire 3, and by 2 through the primary coil and via 1 to local battery, through that to post b, and by 12 to post c and to earth. By depressing the key k^2 the circuit is opened and closed, and the two local batteries—one at each end of the line—become operative to ring the bell.

I will mention that the two receivers herein described and the two transmitters may all be connected in one line and operated without the aid of induction-coils, but the results are not equal to that from the use of the coil; also, that the receivers will act as transmitters by reason of the fact that when the spring g and chalk are at rest the resistance of the whole is generally about twenty-five hundred ohms, and this resistance is reduced instantaneously to two hundred or three hundred ohms by the slightest movement of either the chalk or the spring; hence the movement of the diaphragm d^2 by the voice produces the same result, or nearly so, as the carbon transmitter. If advantage is to be taken of this fact, the surface of the spring g should be reduced to increase the effect, and an induction-coil having a primary coil of high resistance used in connection with the apparatus, although it is not absolutely necessary, as the direct results are nearly as good.

In preparing the chalk I prefer to use a salt of mercury mixed with caustic soda. The action takes place no matter what the proportions are. The mercury salt I prefer to use is the acetate of mercury.

I will mention that this moisture of the chalk may be regulated automatically by taking advantage of the fact that the normal friction of the chalk increases as it becomes drier.

A spring resting on the chalk is connected to the wetting-roller, and has such a pressure and counteracting spring that when the chalk has its proper moisture the friction during rotation is insufficient to produce the necessary traction to lift the roller; but when it becomes drier the traction becomes sufficient to lift the wetting-roller, and it supplies moisture until the traction is reduced below a certain point and it falls.

I claim as my invention—

1. The combination, with the acoustic telegraph and diaphragm, of a roller that receives a revolving motion and contains an electrolytic material, and a spring or presser connected with the diaphragm and resting upon the roller, substantially as set forth.

2. The combination, in an acoustic telegraph, of a moving surface containing electrolytic material, a diaphragm, a presser or spring extending from the diaphragm and resting on such surface, a screw through a fixed support acting upon the presser to vary or adjust the friction between the moving surface and the presser, substantially as set forth.

3. The roller a', revolved by power, and the

presser g and diaphragm d^2, in combination with the receptacle n' for liquid and the transfer-roller r, substantially as set forth.

4. The arrangement of local circuit, magnetic call, telephone-receiver, telephone-transmitter, switch, and line-connections, substantially as set forth, whereby the call and the receiving-instrument are in the line-circuit, and the local battery is also put upon the line, substantially as specified.

Signed by me this 24th day of March, A. D. 1879.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,

WM. CARMAN.

T. A. EDISON.
Carbon Telephone.

No. 222,390. Patented Dec. 9, 1879.

Fig. 1.

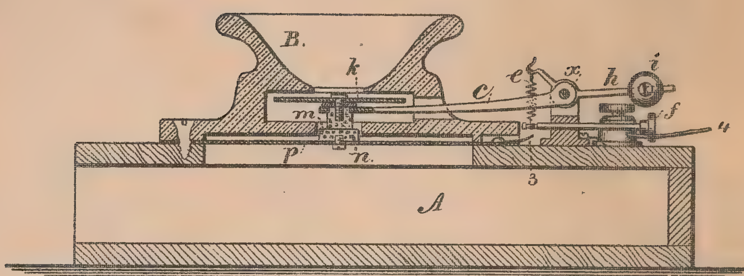
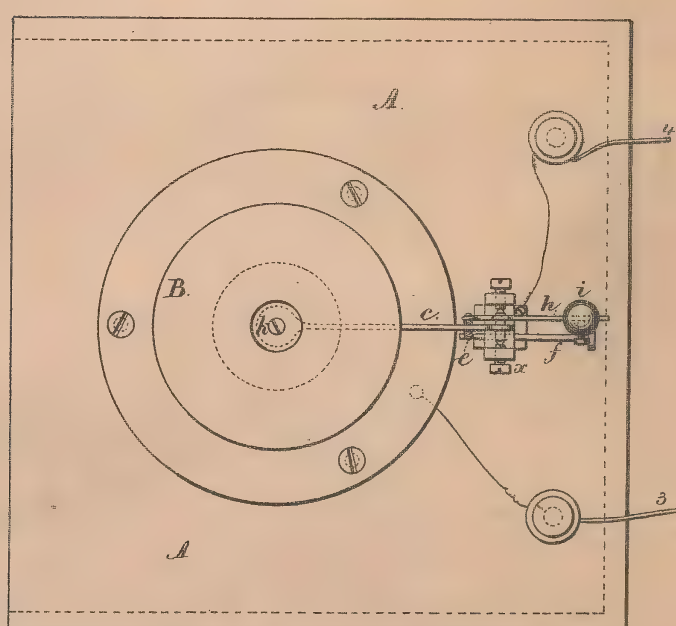


Fig. 2.



Witnesses
Chas. H. Smith
Geo. T. Pinckney

Inventor
Thomas Alva Edison
per Lemuel W. Serrell
atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN CARBON-TELEPHONES.

Specification forming part of Letters Patent No. **222,390**, dated December 9, 1879; application filed November 11, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Telephones, of which the following is a specification.

This invention I term the "micro telephone," in consequence of the same responding to minute vibrations of the instrument itself, transmitted to it by any solid body, or of the atmosphere, and in so doing transmitting electric pulsations to a distance, where they can be received by an ordinary telephone.

In the drawings, Figure 1 is a section of the instrument, and Fig. 2 is a plan of the same.

The box A is of a suitable size and shape for holding the apparatus and for acting as a resonant case, one side thereof being open. This case conveys to the apparatus any vibrations or disturbance resulting from the sound-vibrations of the atmosphere or from the vibration of the solid material upon which the box rests.

In the box A is an opening, preferably round, in which is the diaphragm *p*, and upon this diaphragm is a piece of compressed finely-divided conducting material, such as carbon, *n*. A second piece of carbon or similar material, *m*, is secured to a lever, *c*, the fulcrum or pivot of which is at *x*.

A lever-arm, *h*, and movable weight *i* may be employed to balance the lever *c* and parts connected therewith, and the delicate spring *e* and adjusting-spindle *f* serve to increase or decrease the pressure of the buttons *m n* upon each other.

The plate *k*, of light material, such as mica, is connected with the lever *c*, and this is within and protected by a funnel or mouth-piece, B, upon the box A.

It is now to be understood that the slightest vibration or jar given to the apparatus—such as that resulting from walking about a room, or from the articulate speech or sound-vibrations—varies the pressure of *m n* upon each other, and in so doing the electric condition of a circuit passing through *p n m c* and wires 3 4 is varied, and a corresponding response occurs in a distant receiving-telephone. The finely-divided carbon or other material between *k* and *p* thus becomes a circuit-regulator, that acts to vary the resistance in proportion to the vibration of the parts.

This transmitter is either included in a short circuit containing a receiving-telephone and battery or in the primary circuit of an induction-coil containing a battery, and whose secondary coil is in the line-wire containing the receiving-telephone.

In my application No. 141, filed July 20, 1877, I have shown a diaphragm and a spring carrying one electrode, and also a second electrode; and in my application No. 178, filed June 2, 1879, I have shown a diaphragm and two springs, with carbon between them. I do not herein lay claim to any of the devices shown in either of the said applications.

I claim as my invention—

1. The combination, with a resonant case or support, of the carbon or similar material, the lever *c*, disk *k*, and circuit-connections, substantially as set forth.

2. The combination of two moving plates or diaphragms, *p* and *k*, with finely-divided carbon or similar material intervening, and the circuit-connections passing through the same, substantially as set forth.

3. The combination, with a resonant case, of two diaphragms or plates, *p* and *k*, upon which sound or other vibrations operate, and a circuit-regulator of finely-divided carbon or other material placed between such plates *k* and *p* and the circuit-connections, substantially as set forth.

Signed by me this 8th day of November, A. D. 1878.

THOMAS A. EDISON.

Witnesses:
S. L. GRIFFIN,
CHAS. BATCHELOR.

T. A. EDISON.
Magneto-Electric Machine.

No. 222,881. Patented Dec. 23, 1879.

Fig. 1.

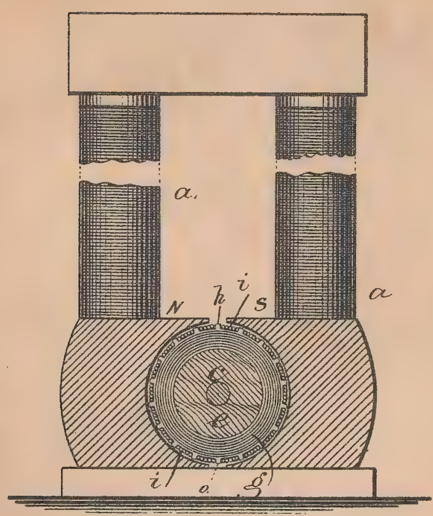


Fig. 3.

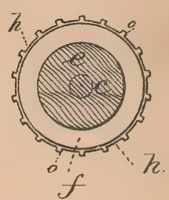


Fig. 4.

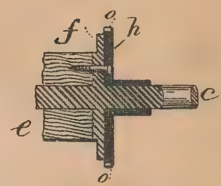


Fig. 2.

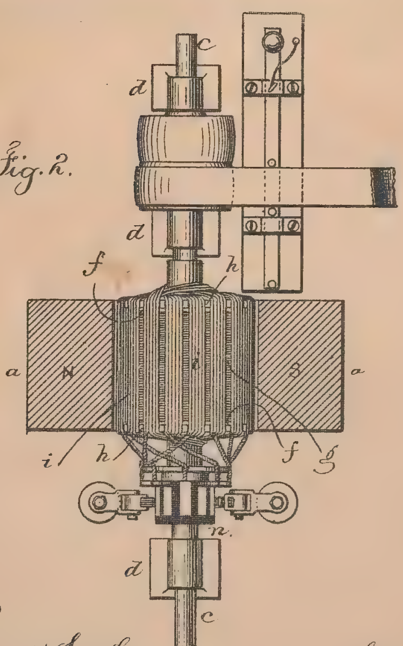
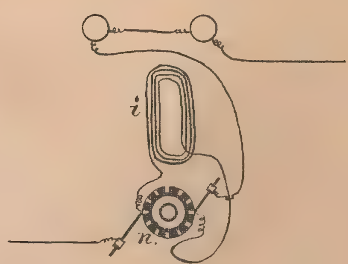


Fig. 5



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison.
per Lemuel W. Serrell
atty.

United States Patent Office.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN MAGNETO-ELECTRIC MACHINES.

Specification forming part of Letters Patent No. **222,881,** dated December 23, 1879; application filed September 10, 1879.

To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the State of New Jersey, have invented an Improvement in Magneto-Electric Machines, (Case 184,) of which the following is a specification.

The object of this invention is to increase the effectiveness and cheapen the construction of the revolving armature.

I make the revolving armature of a cylinder of wood with two iron heads, and around the cylinder and between the heads fine iron wire is wound. At the ends of the cylinder outside the iron heads there are disks of hard rubber or other insulating material, and the wires forming the induction-helix are wound lengthwise of the cylinder into notches in the edges of the disks. This insures the proper insulation of the induction-helix, even if the insulating-covering of the wires may be injured, and the fine iron-wire cylinder forms a magnet by induction from the field-of-force magnet, and the wires running circumferentially also up magnetic poles in the revolving armature, and with the aid of the commutator the magnetic poles always remain at the right place, on account of the quick discharging time of the iron-wire magnet, and therefore are practically regardless of the speed of revolution, and render it unnecessary to adjust the commutators for different speeds of revolution.

In the drawings, Figure 1 is an elevation of the field-of-force magnet, with the poles and armature-cylinder in section. Fig. 2 is a plan of the armature-cylinder, with the poles in section. Fig. 3 represents the wooden cylinder sectionally without the wire helix. Fig. 4 is a section of one end of the armature-cylinder, and Fig. 5 is a diagram of the circuit-connections.

The field-of-force magnet *a* is provided with the poles N S, and the same may be either a permanent magnet or electro-magnet, but preferably the latter, and the helix thereof in the circuit from the armature-helix, or it may be energized separately. The pole-faces are concave.

The shaft *c* is in bearings *d*, and has a wooden cylinder, *e*, between the two iron heads *f*, and *g* is the helix of iron wire wound into the space between the heads *f*.

The insulating-heads *h*, of hard rubber, vulcanized fiber, or equivalent material, are secured outside the heads *f*, and are of larger diameter, so that the helix-wires *i*, that are wound longitudinally, may be kept from contact with the iron helix *g* or heads *f*, so that the current may not be short-circuited, even if the insulation of the wires *i* is defective. The projections *o* around the heads *h* serve as guides to retain the wires that are wound into the notches between said projections.

The longitudinal wires *i* are connected to the commutator-plates *n*, from which the brushes pass the current to the binding-screws, and thence to the object that is to be supplied with the electric current. The wires *i* may be wound in the manner set forth in my application No. 177.

In use the poles N S of the field-magnet energize by induction the iron-wire helix *g*, and the wires of the armature-coil *i* are carried across or cut the lines of magnetism, so as to obtain a maximum effect in setting up a current in said induction-helix.

The bobbin, after winding, is served with German-silver wire in several places to keep the induction-wires against the cylinder.

I do not claim a dynamo-magneto-electric machine wherein a cylindrical armature coiled with insulated wire wound longitudinally on the exterior thereof and provided with a commutator is caused to rotate between curved branches of electro-magnets, the coils of which are in electric circuit from the commutator to the terminals of the machine, as I prefer not to include the helix of the field-magnet in the circuit from the commutator.

I claim as my invention—

The cylinder *e*, of wood or similar material, with the iron heads *f* and intervening helix of fine iron wire, in combination with the disks *h*, of non-conducting material, and the induction-helix *i*, wound lengthwise and into notches in the edges of the insulating-disks, substantially as set forth.

Signed by me this 4th day of September, A. D. 1879.

THOS. A. EDISON.

Witnesses:
S. L. Griffin,
Frank McLaughlin.

T. A. EDISON.
Electric-Lights.

No. 214,636. Patented April 22, 1879.

Fig. 1.

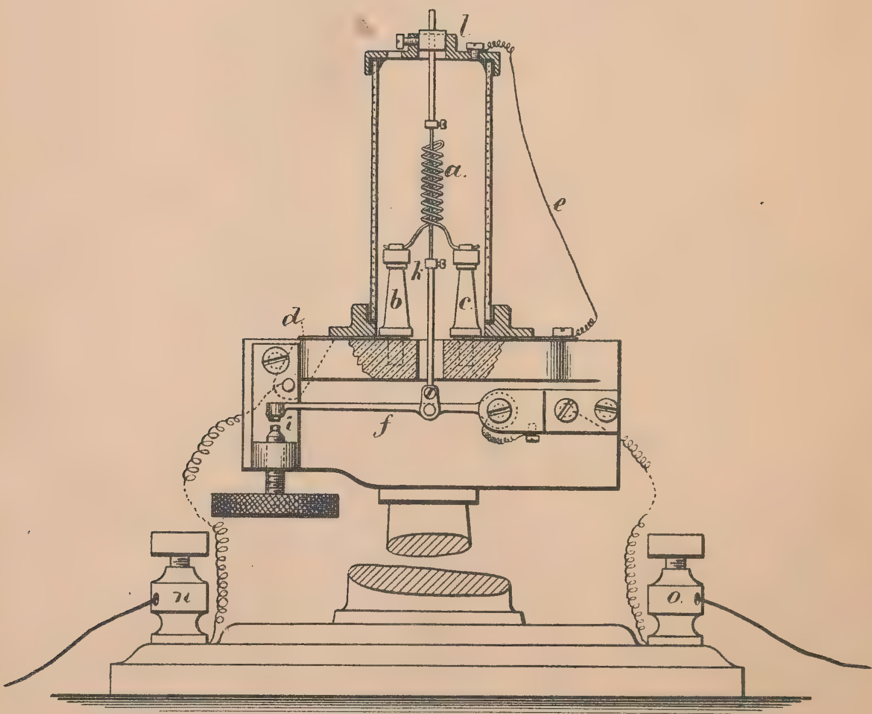
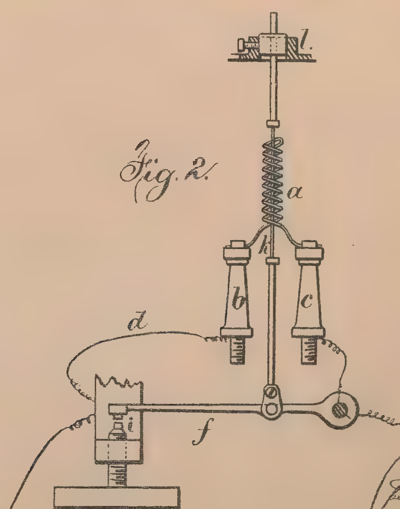


Fig. 2.



Witnesses
Chas H. Smith
Geo. T. Pinckney

Inventor
Thomas A. Edison
per Lemuel W. Serrell
atty

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. **214,636**, dated April 22, 1879; application filed October 14, 1878.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, of which the following is a specification.

Electric lights have been produced by a coil or strip of platina or other metal that requires a high temperature to melt, the electric current rendering the same incandescent. In all such lights there is danger of the metal melting and destroying the apparatus, and breaking the continuity of the circuit.

My improvement is made for regulating the electric current passing through such incandescent conductor automatically, and preventing its temperature rising to the melting-point, thus producing a reliable electric light by rendering conducting substances incandescent by passing an electric current through them.

In my apparatus the heat evolved or developed is made to regulate the electric current, so that the heat cannot become too intense, because the current is lessened by the effect of the heat when certain temperatures are reached, thereby preventing injury to the incandescent substance, by keeping the heat at all times below the melting-point of the incandescent substance.

Various devices for carrying my improvement into practice may be employed, and I have tested a large number. I however have shown in the drawings my improvement in a convenient form, and contemplate obtaining separate patents hereafter for other and various details of construction, and I state my present invention to relate, broadly, to the combination, with an electric light produced by incandescence, of an automatic thermal regulator for the electric current.

Figure 1 represents the electric-light apparatus in the form in which the thermal regulator acts by the heating effect of the current itself, and Fig. 2 illustrates the same invention when the radiated heat from the incandescent conductor operates the thermal regulator.

The incandescent metal is to be platinum, rhodium, iridium, titanium, or any other suitable conductor having a high fusing-point, and the same is used in the form of a wire or thin plate or leaf.

I have shown the platinum wire *a* as a double spiral, the two ends terminating upon the posts *b c*, to which the conductors *d e* are connected. The double spiral *a* is free to expand or contract by the heat, as both ends are below the spiral.

A circuit-closing lever, *f*, is introduced in the electric circuit, the points of contact being at *i*, and there is a platina or similar wire, *k*, connected from the lever *f* to the head-piece or other support *l*.

The current from a magneto-electric machine, a battery, or any other source of electric energy, is connected to the binding-posts *n o*, and when contact at *i* is broken the current passes from *o* through lever *f*, wire *k*, support *l*, wire *e*, post *c*, platina coil *a*, post *b*, and wire *d*, or metallic connection, to binding-screw *n*. In this instance the wire *k*, being small, is acted upon by the electric current and heated, and by its expansion the lever *f* is allowed to close upon *i* and short-circuit the current.

The contact-point *i* is movable, and it is adjusted so that the shunt will not be closed until the temperature of the apparatus arrives at the desired height, and, by diverting a portion or the whole of the current, the temperature of the incandescent conductor is maintained in such a manner that there will be no risk of the apparatus being injured by excessive heat or the conductor fused.

If the wire *k* is small, so as to be heated by the electricity itself, it may be placed in any convenient position relatively to the light; but if such wire is heated by radiation from the electric light, then it should be adjacent to the incandescent material.

In all instances, the expansion or contraction of a suitable material under changes of temperature forms a thermostatic current-regulator that operates automatically, to prevent injury to the apparatus and to the body heated by the current.

In Fig. 2 the current does not pass through the wire *k*, and the short-circuiting lever is operated by the radiated heat expanding the wire *k*. This in practice does not operate as rapidly as the device shown in Fig. 1.

The electric light may be surrounded by a glass tube or any other suitable device, such as two concentric glass tubes with the intervening space filled with alum-water or other bad conductor of heat, the object being to retain the heat of the incandescent metal and prevent loss by radiation, thus requiring less current to supply the loss by radiation.

I am aware that the electric current has been used to produce heat, and that such heat has been employed to vary the relative position of the light-giving electrodes and the length of the intervening arc. In my light there is no electric arc.

I claim as my invention—

1. In combination with an electric light having a continuous incandescent conductor, a thermostatic circuit-regulator, substantially as set forth.

2. In combination with an electric light, a thermostatically-operated shunt, substantially as set forth.

Signed by me this 5th day of October, A. D. 1878.

THOMAS A. EDISON.

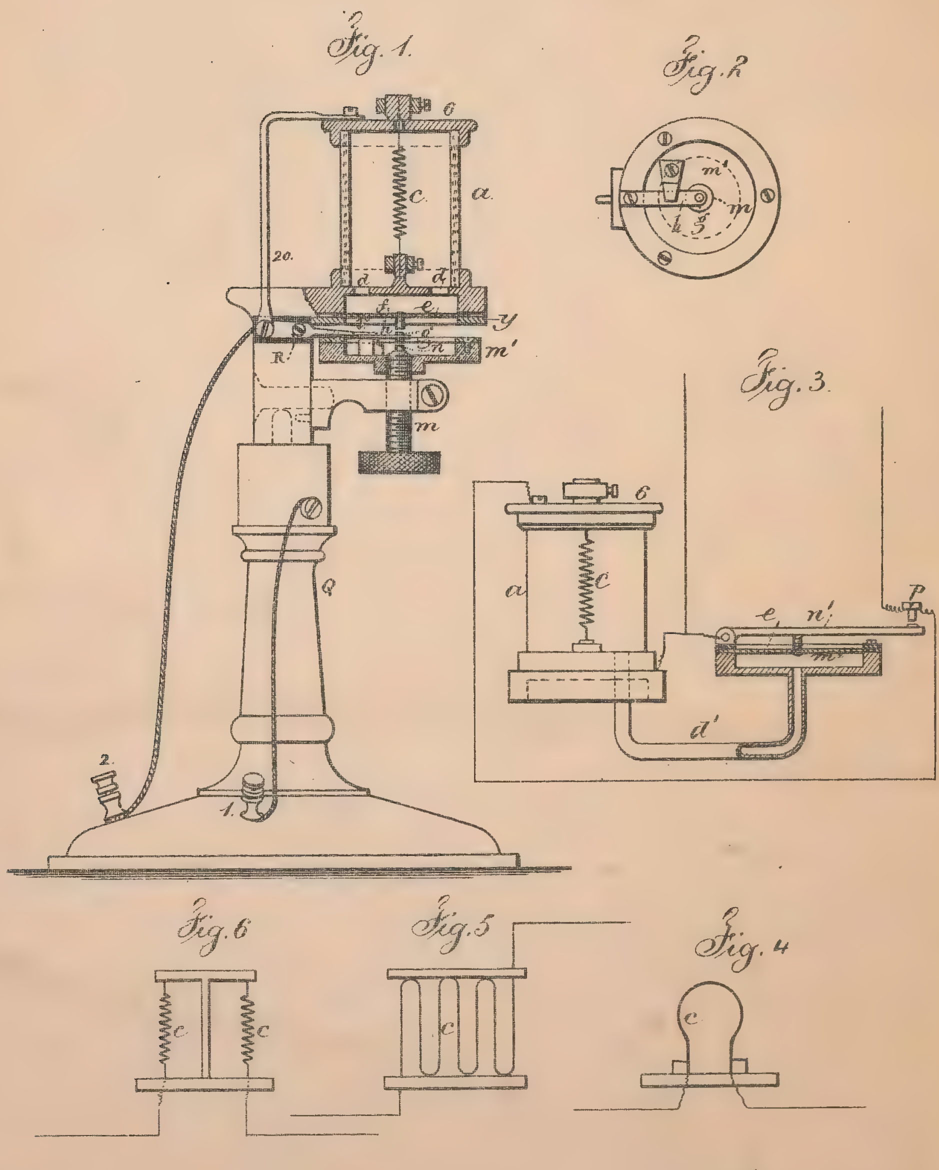
Witnesses:

ALFRID SWANSON,
STOCKTON L. GRIFFIN.

T. A. EDISON.

Thermal-Regulator for Electric-Lights.

No. 214,637. Patented April 22, 1879.



Witnesses

Chas. H. Smith
Geo. T. Pinckney

Inventor

Thomas A. Edison
per Lemuel W. Serrell atty.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

IMPROVEMENT IN THERMAL REGULATORS FOR ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. 214,637, dated April 22, 1879; application filed November 18, 1878.

To all whom it may concern:

Be it known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, have invented an Improvement in Electric Lights, of which the following is a specification. (No. 162.)

The object of this invention is to devise a reliable and economical electric lamp to give light by incandescence due to the passage of the electric current through conductors of electricity, so that a great number of lamps may be used in one electric circuit.

The invention consists in causing the heat generated by the incandescent conductor to expand the air or fluid in the containing-chamber as its temperature rises, the pressure thus created serving to move outwardly a yielding material, such as a diaphragm, which, in its turn, serves to control the passage of the electric current through the incandescent body by means of contact-points or circuit-regulators, and thus the temperature of the incandescent conductor will be regulated automatically.

In the drawings, Figure 1 is a sectional elevation of the electric lamp, and Fig. 2 is a plan of a portion of the same. The other figures are separately referred to.

a is a glass tube or vessel containing spiral or strip *c* of iridium or equivalent metal, through which the current passes. *b* is the top plate, to which the spiral *c* is connected. The glass tube is secured to the metallic standard Q. *e* is a diaphragm closing the bottom of the lower chamber. There is a partition between the chamber containing the spiral *c* and the chamber of the diaphragm; but air circulates freely between the chambers through the holes *d d d*. When the spiral is heated by the passage of the current the air in the chambers expands and bulges the diaphragm outwardly. On the center of the diaphragm is a platina point, *f*, immediately opposite another platina point, *g*, on a spring, *h*. This, again, is opposite another platina point, *n*, on the screw *m*.

m' is a disk of insulating material, on the top of which is a brass ring in electrical connection with the spring *h*. A rubbing contact-spring, *v*, connects this ring to the insulated plate R and the binding-post 2 on the base. The frame Q is connected to the other binding-post, 1. A wire, 20, connects the spiral of the light with the plate R and binding-post 2.

When no current passes in the circuit containing this instrument the air in the chamber is of the same pressure as the atmosphere, and the points *f* and *g* and *n* are not in contact. If, now, the current is allowed to circulate in the line, it passes, say, from binding-post 2 to R, thence through wire 20 to the top *b*, down through spiral *c* to base Q, to the other binding-post, 1. When the spiral *c* reaches within a few degrees of its melting-point the expansion of the air will have bulged out the diaphragm *e* and brought the points *f* and *g* together, thus short-circuiting the current from the spiral, as it now must nearly all pass from binding-post 2 to R, thence through spring *v* to the ring *y*, through spring *h* to *g*, through *f* to diaphragm *e*, to Q, and back to binding-post 1. When thus short-circuited the temperature of both the air and spiral falls by radiation, and when it reaches a certain point the diaphragm and point *f* leaves *g*, and the current again passes through *c* and raises its temperature, and the same action takes place. This regulation is so rapid that the eye does not perceive any diminution in the strength of the light. The object of the contact between *g* and *n* is that in case *f* and *g* should fail to make contact the short circuit would still take place, as *n* and *f* are both connected to Q. It is obvious that this method may be applied in many ways. For instance, the diaphragm might give motion to a lever or spring through which the contacts might be made, and this second chamber may be separated from the one containing the spiral *c*, as shown in Fig. 3. A tube, *d'*, leads from the chamber containing the spiral to the second chamber, m^2, closed by the diaphragm *e*.

n' is a lever which is moved by the movement of the diaphragm, and serves to short-circuit the spiral *c* when it comes in contact with the point *p*.

Mercury may replace air in the tube *d* and chamber m^2, the pressure of the air or gas in *a* acting through such mercury on the diaphragm *e*; or the mercury may come into contact with the point *p* to make direct circuit through the mercury.

The incandescent conductors may be made in either of the forms shown in Figs. 4, 5, or 6.

In my application No. 156, filed October 14, 1878, I have shown a thermostatic circuit-reg-

ulator in connection with the electric light. I do not therefore herein claim any feature set forth in said prior application.

I claim as my invention—

The method specified of regulating the temperature of the incandescent light-giving body by the expansion of the air or gas in the closed vessel containing the light, acting automatically in the electric circuit, substantially a[s] set forth.

Signed by me this 14th day of November, A. D. 1878.

THOMAS A. EDISON.

Witnesses:

STOCKTON L. GRIFFIN,
CHAS. BATCHELOR.